High Band GE Custom MVP (Exec II) 222 Mhz Conversion

High-band GE MVP/EXECII Exciter on 220 Mhz (19D423293G2) Rev. C 1 April 1990

Procedure:

1. Remove the cans from T105, T106, T107 and T108.
2. Remove the T107 and T108 coils.
3. Remove T105 and T106 coils and install them in the T107 and T108 locations.
4. Remove all but 3 1/2 turns from the T107 and T108 coils and install them in the T105 and T106 positions.
5. Remove R134 and L107. R134 may already be missing.
6. Replace R130 with a jumper.
7. Replace the following with the new values shown:

   a. C138 - 6.2pf
   b. C139 - 5.1pf
   c. C141 - 3.9pf
   d. C146 - 13pf
   e. C147 - 6.8pf
   f. C149 - 22pf
   g. R101 - 100 1/4 watt
   h. R126 - 470 1/4 watt

8. Install a 1.8K 1/4 watt resistor, from the base of Q108 to the intersection of L108 and C144, on the bottom of the board.
9. Reinstall the coil cans.

Notes:

1. The last doubler, Q107, is now a tripler.
2. The new crystal formula is: xtal = f/18. Calculate the fundamental frequency and put it back into the original crystal formula. Order the equivalent high-band frequency.

High-band GE MVP/EXECII Receiver on 220 Mhz

(150-174 MHZ)
REVC
1 April 1990

Oscillator Multiplier Board (19D423241G1):

1. Install a 12pf capacitor in the space reserved for C412.
2. Install a jumper between the bottom two turns of L403 closest to the position reserved for C417.
3. Install a jumper from the center of L403 to the next turn, closest to R413.

High Band Adapter Board (19B227258):

1. Remove C460.

Mixer Board (19C320153):

1. Install a jumper from the center of L502 to the first turn of the inductor going towards C504.
2. Install a jumper from the bottom center turn of L502 (closest to the gate of Q501) to the ground plane to the right of L502 and below C502.

RF Assembly (19D416693):

1. Remove the helical resonators:

   L301/311, L302/L312, L303/313, L304/314, L305/315, L306/L316 and L307/L317.

   Remove 1 3/4 turns from the cold end of each resonator and reinstall. A soldering iron in the few hundred watt range is required to complete the procedure.

Motorola T71RTN MICOR VHF LO Conversions

HEWLETT PACKARD

Printed in USA January 1991

Printing History

Print History

Revision	Print Date	Change
First Draft	January 1991	by Paul J. Lorona KB6MIP
Revision A.00.00	04 March 1991	Add Chapter 6
Revision A.01.00	16 April 1991	Modify Chapter 4

Contents

Figures

Tables

1

Mid-Split to High-Split

This chapter outlines parts required to change a Mid-Split (36MHz to 42MHz) MICOR to a High-Split (42MHz to 50MHz) MICOR. The tables that follow show the part numbers of the new parts you need to install, and in some instances show the value of the old part as well.

Note This document assumes that the technician has a copy of the Motorola manual for the TX1RTN series MICOR VHF LO radio sets. If this is not the case, it will not be possible to modify the radio, as the technician will have no way of locating parts and jumpers referred to.

Table 1-1. Receiver Parts to be Changed

Designator	Change from	Change to	New Part Motorola #	Extender	Description
L105-L107			24D84113B01		Coil, RF
L104			24D84115B13		Coil, RF
L122		0.30μH	24C84270C01		Choke
L304			24D84115B06	*	Coil, RF
L305			24D84115B09	*	Coil, RF

L105-107, and L304-305 should be purchased from Motorola.

Table 1-2. Transmitter P.A. Parts to be Changed

Designator	Change from	Change to	New Part Motorola #	Description
C509	200pf	200pf	21-840812	Capacitor, ±5%, 500V silver mica
C510	280pf	200pf	21D84426B09	Capacitor, ±5%, 500V silver mica
C513	510pf	300pf	21-859944	Capacitor, ±5%, 500V silver mica
C517	5pf	2pf	21K857336	Capacitor, ±0.25pf, NP0
C519-C527	1000pf	665pf	21D84426B48	Capacitor, ±5%, 500V silver mica
C502-C503	55-282pf	24-188pf	20C84218B02	Variable capacitor, 175V
R501	22Ω	47Ω	6S129233	Resistor, 1/4W, ±10%
R502	3.9KΩ	1KΩ	6S127802	Resistor, 1/4W, ±10%
R503	22Ω	100Ω	6S129753	Resistor, 1/4W, ±10%
R504	100Ω	220Ω	6S6389	Resistor, 1W, ±10%
R505	10Ω	2.7Ω	6S124B55	Resistor, 1/4W, ±5%
R511	68Ω	150Ω	6S6330	Resistor, 1W, ±10%
R526		REMOVE		
R527		100Ω	6-124C25	Resistor, 1/4W, ±10%
R530		REMOVE		
R531		REMOVE		
Z501			TFB6024A	Harmonic Filter 42-50MHz

C502, C503, and Z501 should be purchased from Motorola. Failure to replace Z501 will limit your output power to about five watts.

Table 1-3. Antenna Match Parts to be Changed

Designator	Change from	Change to	New Part Motorola #	Description
L601		0.28μH	24C84212B02	Coil, RF

L601 should be purchased from Motorola. See the information in the manual concerning placement of this device and jumpers on the antenna matching board.

2

High-split to Six Meters

This chapter outlines parts required to modify a High-Split (42MHz to 50MHz) MICOR for operations on the Six Meter Amateur band. The parts required for this modification should be available over the counter at any better electronics parts supply house. The part values shown are for the replacement parts, not the original value. The technician should refer to the Motorola TX1RTN MICOR manual for parts location information.

71
61
51
41

Table 2-1.
Receiver: Multiplier / Injection Amplifier Parts to be Changed

Designator	Replace With	Description
C108	22pf	Capacitor, ±5%, 500V silver mica
C109-C110	62pf	Capacitor, ±5%, 500V silver mica
C125	33pf	Capacitor, ±5%, 500V silver mica
C127	33pf	Capacitor, ±5%, 500V silver mica

Table 2-2.
Receiver: RF Preselector Parts to be Changed

Designator	Replace With	Description
C113	18pf	Capacitor, ±5%, 500V silver mica
C114	120pf	Capacitor, ±5%, 500V silver mica
C116	18pf	Capacitor, ±5%, 500V silver mica
C118	18pf	Capacitor, ±5%, 500V silver mica
C120	18pf	Capacitor, ±5%, 500V silver mica
C122	3pf	Capacitor, ±0.25pf, NP0

Table 2-3. Transmitter: Exciter Parts to be Changed

Designator	Replace With	Description
C425	18pf	Capacitor, ±5%, 500V silver mica
C429	18pf	Capacitor, ±5%, 500V silver mica
C430	90pf	Capacitor, ±5%, 500V silver mica
C432	5pf	Capacitor, ±0.25pf, NP0
C434	240pf	Capacitor, ±5%, 500V silver mica
C435	150pf	Capacitor, ±5%, 500V silver mica
C438	68pf	Capacitor, ±5%, 500V silver mica
C439	3pf	Capacitor, ±0.25pf, NP0
C441	82pf	Capacitor, ±5%, 500V silver mica
C442	200pf	Capacitor, ±5%, 500V silver mica
C444	56pf	Capacitor, ±5%, 500V silver mica
C445	62pf	Capacitor, ±5%, 500V silver mica
C446	2pf	Capacitor, ±0.25pf, NP0
C448	33pf	Capacitor, ±5%, 500V silver mica
C449	100pf	Capacitor, ±5%, 500V silver mica
C451	91pf	Capacitor, ±5%, 500V silver mica
C452	47pf	Capacitor, ±5%, 500V silver mica
C453	2pf	Capacitor, ±0.25pf, NP0
C455	39pf	Capacitor, ±5%, 500V silver mica
C456	160pf	Capacitor, ±5%, 500V silver mica

Note

If you wish your radio to be a carrier squelch radio, you must install a jumper on the exciter board between P902 pins 8 and 10. This jumper is shown on the schematic and parts locator as JU405.

Warning

In manual part number 68P81008E35-N, the information shown for exciter part number TLB8160A Series is incorrect. In the chart on page 10-19, the information for capacitor C459 is shown in the line labeled C456. The information for C456 is shown in the "REVISIONS" on the back side of page 10-19. Ignore the information shown for C459 in the chart on page 10-19.

Note

In some radios, most notably the CHP radios, changing C439 to 3pf may cause the exciter to not operate properly, if at all, at the low end of the FM subband on six meters. Changing this capacitor back to the stock value of 4.7pf (for a High Split radio) should alleviate this problem.

3

Alternate High-Split to Six Meters

This is an alternate conversion which requires fewer parts but also requires modifying the tuning coils in the receiver and exciter.

Modify coils L405, 406, 407, and 408 in the exciter by removing one turn from the top of each coil. The top of the coil is the end farthest away from the circuit board.

Modify L105 in the receiver in the same way as the coils were modified in the exciter. Replace the indicated capacitors in the table following.

Table 3-1. Alternate Receiver Mod Parts To Be Changed

Designator	Replace With	Description
C108	39pf	Capacitor, ±5%, 500V silver mica
C109	68pf	Capacitor, ±5%, 500V silver mica
C116	20pf	Capacitor, ±5%, 500V silver mica
C118	20pf	Capacitor, ±5%, 500V silver mica
C120	20pf	Capacitor, ±5%, 500V silver mica
C122	2pf	Capacitor, ±5%, 500V silver mica
C125	33pf	Capacitor, ±5%, 500V silver mica
C127	33pf	Capacitor, ±5%, 500V silver mica

Note

If you wish your radio to be a carrier squelch radio, you must install a jumper on the exciter board between P902 pins 8 and 10. This jumper is shown on the schematic and parts locator as JU405.

4

Channel Elements

The Motorola MICOR VHF LO band radios use the K1003 (receive) and K1004 (transmit) channel elements. Due to lack of availability of these channel elements, it may be desirable to use the K1005 (receive) and K1007 (transmit) channel elements that the VHF HI band radios use.

The K1003 and K1005 receive channel elements are interchangeable and no modifications are required. The K1007 needs some minor modification as described here to function as a K1004 transmit element.

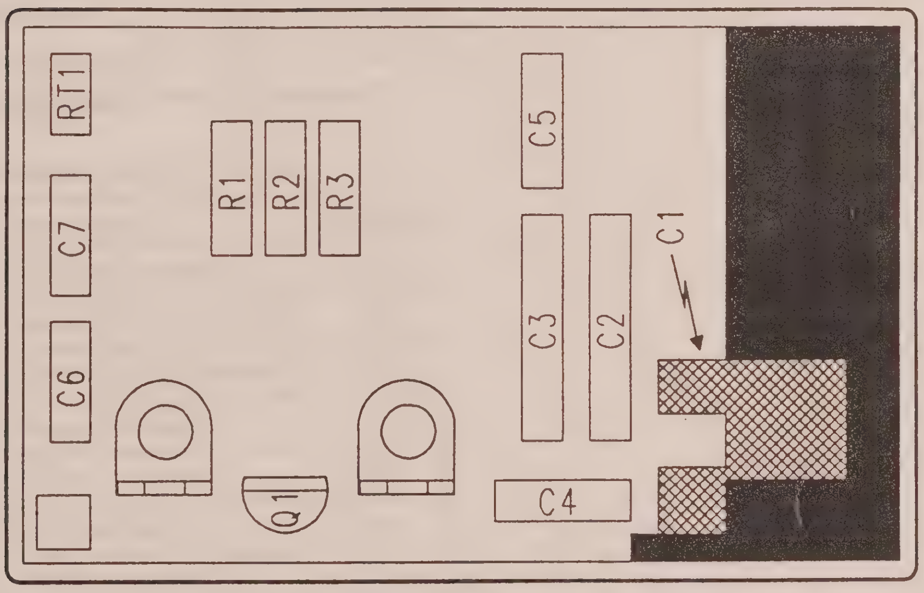


Figure 4-1. K1004 Channel Element Part Locator Diagram

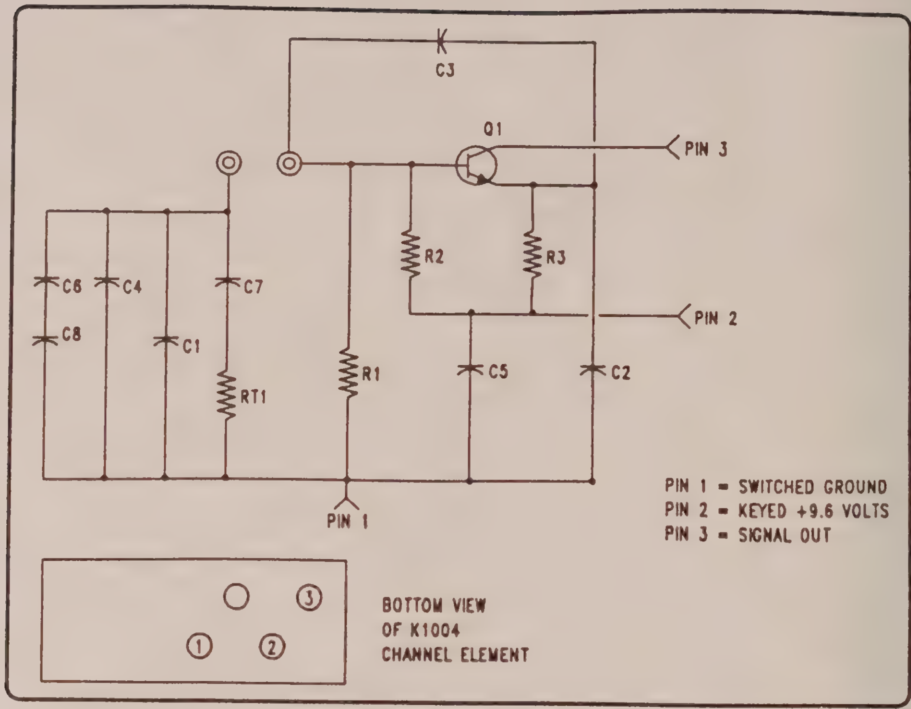


Figure 4-2. K1004 Channel Element Schematic Diagram

Table 4-1. K1004 Channel Element Parts List

Designator	Description	Motorola Part #
C1	Variable Capacitor 3.5pf-14pf	
C2	Capacitor, 500V silver mica, 190pf	
C3	Capacitor, 500V silver mica, 220pf	
C4	Capacitor, ceramic, 20pf	
C5	Capacitor, ceramic, .01μf	
C6	Capacitor, NPO, 7pf	
C7	Capacitor, NPO, 9.5pf	
C8	Capacitor?	
Q1	Transistor, silicon NPN	M9571
R1	Resistor, 1/4W, 5%, carbon, 10KΩ	
R2	Resistor, 1/4W, 5%, carbon, 10KΩ	
R3	Resistor, 1/4W, 5%, carbon, 2.2KΩ	
RT1	Thermistor	

1. Refer to the two preceding diagrams and parts list to change the parts specified.
2. Remove the element cover and protective mica sleeve.

3. Remove the crystal (if there is one) from the standoffs.
4. Under where the crystal was mounted you will find three 1/4 watt resistors: two 4.7KΩ (R1 and R2), and one 820Ω (R3). Replace each 4.7KΩ with a 10KΩ resistor, replace the 820Ω with a 2.2KΩ resistor.
5. Locate capacitor C7 and replace it with a 9.5pf NPO capacitor.
6. Install the crystal in the standoffs.
7. Replace the mica sleeve and cover.

5

CHP MICORs

The California Highway Patrol purchased MICORs with a complete second receiver and audio board mounted in a “doghouse” on the back of a standard MICOR. These radios operated as mobile repeaters when configured with the General Electric “Vehicular Extender” option. This option allowed the patrol officer to stay in radio contact outside of his vehicle using a VHF handheld transceiver operating on 150MHz. The officer would transmit on 150MHz, the vehicular extender would receive the 150MHz signal and rebroadcast it on 43MHz through the MICOR. The dispatcher would respond on 43MHz, the MICOR would receive on 43MHz, and the vehicular extender would pass the dispatcher's message on to the patrol officer on 150MHz.

Conversion to Standard MICOR

Most of the CHP MICORs available on the Amateur market today do not have the Vehicular Extender option in them, but still have the control group and second receiver installed. This section will describe how to convert the CHP MICOR to a stock 4 channel MICOR. As in previous sections, it is necessary to have a Motorola MICOR manual at your disposal.

Removing the Second Receiver

Note

A new part is required from Motorola to complete this procedure. It is the rear chassis plate, Motorola part # 64-84100B01.

1. **Remove the Antenna Cable Splitter**
   a. Disconnect antenna cable at splitter.
   b. Remove screw holding splitter to control board and lift the splitter out.
   c. Disconnect the cables running from the splitter to the two receiver boards at the receivers.
   d. Connect the remaining antenna cable to the front receiver board.
2. **Remove the Aft Interface Board**

a. Remove the two screws holding the aft interface board to the chassis at the rear of the control board.

b. Disconnect brown wire which runs from the aft interface board to the front panel connector at the front panel connector.

c. Remove the eight screws (four on top, four on the bottom) holding the Second Receiver "doghouse" to the back of the unit. Pull the "doghouse" slightly away from the main unit (0.5 inches or so).

d. Fold the aft interface board back over the "doghouse".

e. Observe the cable bundle as it passes through the rear chassis from the "doghouse" to the front panel connector. As wires from this bundle go to connecting points on the control board, disconnect them. 13 wires connect to the control board, 3 connect to the front panel connector (one is soldered on), and 2 go to the audio / squelch board.

f. Carefully remove the "doghouse" from the main chassis.

g. Remove and retain the plastic cover guide and mounting screws from the "doghouse" assembly.

h. Install the plastic cover guide with the mounting screws to the new back chassis plate. Using the screws removed in step (a), mount the new back plate to the main chassis.

3. **Remove the Forward Interface Board**

   a. Remove the two screws holding the forward interface board to the front panel connector.

   b. Disconnect the two wires running from the forward interface board to the front panel connector at the front panel connector.

   c. Remove the forward interface board.

   d. Remove and retain the two screws holding the forward interface board mounting bracket to the front panel connector.

   e. Remove the forward interface board mounting bracket and replace the two screws from step (d) in the front panel connector.

   f. Remove the white-blue wire from the front panel connector and control board.

Modifying the Audio / Squelch Board

Note

A part is required to complete this procedure. It is a 1000pf capacitor, ±5%, 500V silver mica.

1. **Remove the Audio / Squelch Board**
   a. Disconnect the red wire from the audio / squelch board to the PL board at the PL board.
   b. Free the two mounting screws which hold the PL board to the chassis and audio / squelch board.
   c. Remove the PL board from the unit.
   d. Turn the unit over and remove the shield covering the audio / squelch board.
   e. Free the four screws holding the audio / squelch board to the chassis.
   f. Remove the audio / squelch board.

2. **Modify the Audio / Squelch Board**

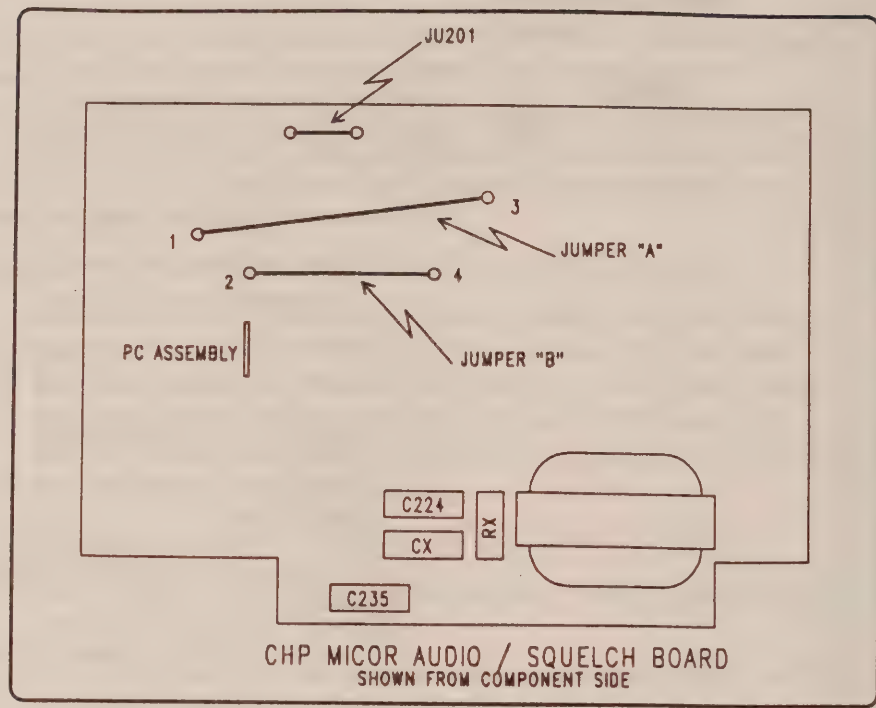


Figure 5-1. Audio / Squelch Board Detail

a. Remove the small printed circuit assembly and red wire from the audio / squelch board.

b. Install a jumper across the lands the circuit board assembly in step (a) was mounted on.

c. Remover jumpers labeled "A" and "B" as shown in Figure 1. Clean the lands on the audio / squelch board.

d. Replace C224 with a 1000pf capacitor.

e. Replace CX with a jumper.

f. Remove RX and discard.

g. Install a jumper between lands labeled "1" and "2" in Figure 1.

h. Install a jumper between land "4" and the post mounted on the audio / squelch board immediately adjacent to land "4". Mount this jumper from the solder side of the board.

i. Install jumper JU201.

j. Reinstall audio / squelch board in RF deck and replace shield.

k. Reinstall receiver PL board in RF deck.

Modifying the ACM

The following steps will convert the customized CHP Alternate Control Module (ACM) to a stock four-channel ACM. Some parts from the "upper" card in the CHP System 90 package will need to be modified, and other parts will need to be purchased.

Warning

This portion of the CHP modification procedure has not been completed at this time.

Modifying the Interconnect Cable

The following steps will convert the CHP interconnect cable for use with either the standard four-channel Alternate Control Module (ACM) alone or for use with the ACM in conjunction with the four-channel scan card.

Note

This procedure requires some jumper cable assembly which in turn requires some Motorola parts: 9 84151B01, bag of 20 connector pins. 24 pins are required, but one bag may suffice if some cables already present in the CHP interconnect cable assembly are used.

- Remove all wires from the large black connector, large white connector, and blue connector using the pin removal tool. Discard the large white connector.
- Cut the wires from the small white connector. Discard the small white connector.
- Fold back all the wires removed from the small white connector, and also the following coded wires:
  - violet
  - white-gray
  - red-blue

  Wire tie these wires to the interconnect cable so they will not become tangled later.

Warning

Do not remove the wires from the two-pin black connector body.

- Twelve jumpers with connector pins at both ends will have to be assembled. It is suggested that these be about eight to twelve inches long and of the same color code as the interconnect cable input wire they are associated with. Color code is not critical, but will aid in any future troubleshooting which may be required. The jumpers will be required if any information is listed on the **Out Of Channel Scan** column in the table below.
- Use the following table to connect the wires to the connector bodies as shown. Read the table from left to right. As an example: the yellow wire from the interconnect cable would connect to the Channel Scan 6-pin connector body at pin # 3 (denoted as 6pCB #3), then a (yellow) jumper would go from the Channel Scan

6-pin connector body pin # 5 (denoted 6pCB #5) to the ACM large black connector body pin # 1 (denoted LB #1). Other abbreviations shown are: 22pCB (22 pin connector body), SB (small black), and BL (blue).

Note

If you do not wish to use the Channel Scan option, skip the two columns labeled **Into Channel Scan** and **Out Of Channel Scan**, and connect the color coded cables directly to the ACM connector bodies as shown in the column labeled **Into ACM.**

Table 5-1. Interconnect Cable Wiring

Interconnect Cable Color	Into Channel Scan	Out Of Channel Scan	Into ACM	Notes
Yellow	6pCB #3	6pCB #5	LB #1	
Black-Violet	6pCB #6	22pCB #2	SB #1	Wire already at SB #1
Black-Green	22pCB #21	22pCB #10	LB #20	
Black-Brown			LB #16	
Black-Yellow			LB #11	
Shield	22pCB #22	22pCB #11	LB #21	
Brown	22pCB #3	22pCB #1	LB #17	Center conductor Red coaxial
Shield	22pCB #13	22pCB #12	LB #10	Shield Red coaxial
Orange			LB #9	
Green			SB #2	Wire already connected
Black-Blue			LB #4	
Black-Orange	22pCB #20	22pCB #9	LB #22	
Blue	22pCB #19	22pCB #8	BL #3	
White	22pCB #18	22pCB #7	BL #4	
Gray	22pCB #17	22pCB #6	BL #5	
Black	22pCB #16	22pCB #5	BL #6	
Black-Red			LB #14	
Black-Gray			LB #7	
Black-White		22pCB #14	BL #1	
Orange	6pCB #4	6pCB #1	LB #13	Transmitter power relay
Green			LB #12	Receiver power
Black			LB #2	Speaker low
Black			LB #3	Speaker high
Brown-Black			LB #6	

6

QLN1301A 12 Frequency Deck

This section describes the interconnections between the standard MICOR deck and the QLN1301A 12 Frequency Option Deck which mounts in place of the stock MICOR back plate. It also describes a modification to reduce or eliminate a wide band noise problem which may occur in units converted from Mid-Split (36MHz to 42MHz) to Six Meters.

QLN1301A Interconnection

The 12 Frequency Option takes four of it's twelve control lines from the traces on the stock MICOR control board. These would be the leads for F1 through F4. Short wires from the control board pass through the back of the radio set to the option deck. See the diagrams following.

Because the first four receive channel elements (F1 - F4) will still be located on the stock receiver assembly, control lines must pass back to the receiver from the option deck. In the diagrams, these are labeled F1 - F4 Receive Select. All other lines are labeled just F1 - F4 Select.

The other eight control lines, F5 through F12, are passed via wire from the front panel connector P901 on the MICOR directly to the option deck.

All twelve transmit channel elements are located on the option deck.

Switched supply voltages are also provided to the option deck from the receiver and exciter boards, and signal outputs are routed to the receiver and exciter through coaxial cable.

Installing a 12 Frequency Option will require the removal of a capacitor from the exciter board, C411. Detail is provided in the diagrams for connecting the coaxial cables to their respective destinations.

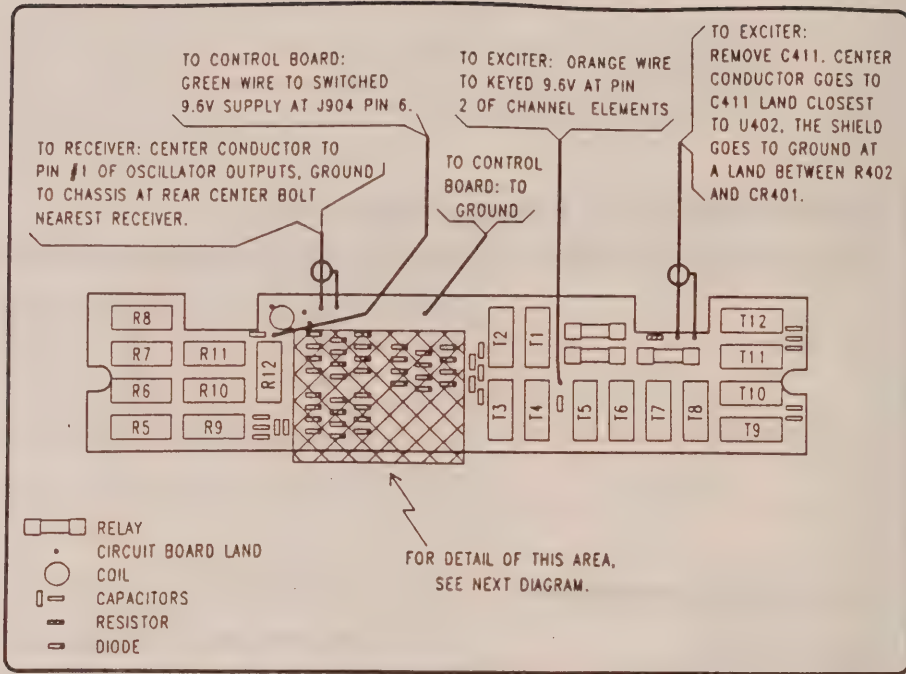


Figure 6-1. QLN1301A Layout And Connection

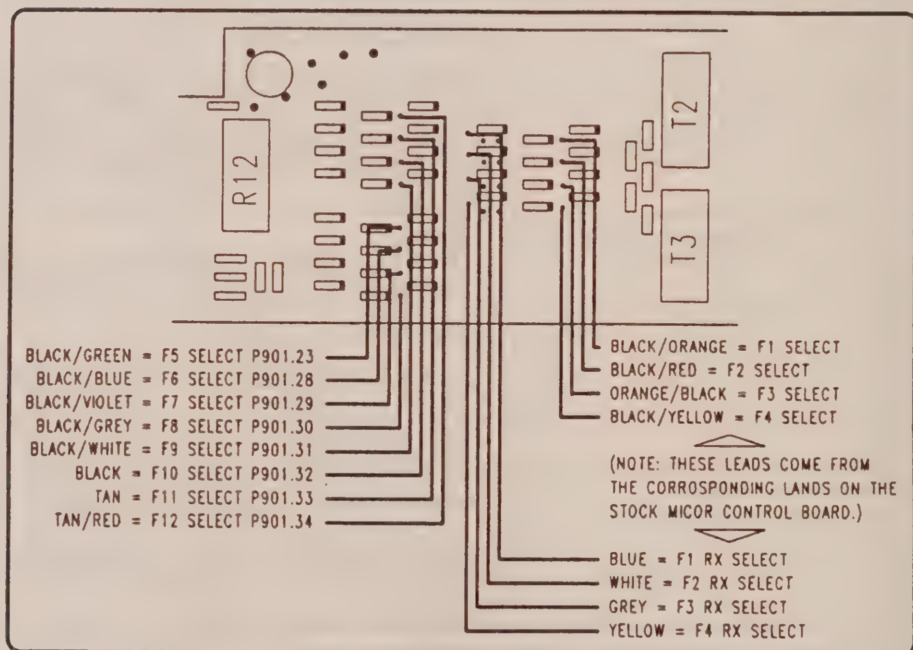


Figure 6-2. QLN1301A Connection Detail

QLN1301A Wideband Noise

In some radios the addition of the QLN1301A 12 Frequency Option will cause a wideband noise problem to occur in transmission. This problem only manifests itself when the radio is radiating through an antenna, it will not be noticed on a test bench with a dummy load.

The problem will appear as several MHz bandwidth of signal in the band of interest (six meters) when the transmitter is keyed. The problem may be more obvious when the radio covers are removed. The cause is RF getting back into the radio in the control lines and/or signal lines for the 12 Frequency Option, and also into the MIC HI and TONE lines from the control head. This problem may not occur in radios with the 55 watt PA, but will almost always occur in the 100 watt PA versions.

The following procedure describes the addition of ferrite beads to various control and signal lines in the radio deck, and also the addition of two decoupling caps in the MIC HI and TONE lines. Motorola part number 76-84069B01, bag of 5 beads, and requires 2 bags will be needed. The value of the capacitors is 680pf, 500V silver mica.

GE MASTR Exec II VHF Vehicular Extender Repeater Conversion

HEWLETT PACKARD

Printed in USA January 1993

Printing History

Print History

Revision	Print Date	Changes
First Draft	August 1991	by Paul J. Lorona KB6MIP
Revision A.01.00	January 1992	complete ch. 3
Revision A.00.01	February 1992	Chapter 1
Revision A.00.02	February 1992	Chapter 5
Revision A.01.00	January 1993	Chapters 1 & 2

Contents

1

220MHz CONVERSION

This chapter applies to any VHF high band MASTR Executive II, and describes the steps necessary to convert the receiver and exciter strips for operation in the 220MHz band. Please note that the high **band power amplifier can not be converted, and must be replaced with an after-market amplifier.** The exciter will develop about 100mW of RF power.

It is recommended that the technician have a copy of the manual for the radio being modified for reference to the following part designators and their locations.

Exciter

High Split

The instructions which follow are for a high split (150.8MHz to 174MHz) exciter. If the unit being modified has a low split (138MHz to 155MHz) exciter, modify it per the documentation in the service manual for a high split configuration. A low split exciter has R134 mounted; it is located next to T108, between the can over T108 and the output connector. If R134 is missing, the exciter is a high split.

1. Remove the cans from T105, T106, T107, and T108.
2. Remove coils T107 and T108.
3. Remove T105 and install it in the T107 location. Remove T106 and install it in the T108 location.
4. Remove all but 3 1/2 turns from the coils removed in step (2.)
5. Install the coils modified in step (4.) in the locations for T105 and T106.
6. Remove L107.
7. Perform the modifications itemized in the following table:

Table 1-1. Exciter Parts To Be Changed

Designator	Replace With	Description
C138	6.2pf	Ceramic disk, ±0.5pf, 500VWDC
C139	5.1pf	Ceramic disk, ±0.5pf, 500VWDC
C141	3.9pf	Ceramic disk, ±0.5pf, 500VWDC
C146	13pf	Ceramic disk, ±5%, 500VWDC
C147	6.8pf	Ceramic disk, ±0.5pf, 500VWDC
C149	22pf	Ceramic disk, ±5%, 500VWDC
R101	0Ω	jumper NO! SHORT 100 Ω
R126	470Ω	1/4 watt, 5% carbon

8. Re-install the coil cans.

9. Tune the exciter per the manual tuning procedure.

TX Crystals

The last doubler, Q107, is now a tripler. This makes the new crystal formula XTAL = f ÷ 18 where XTAL is the crystal oscillating frequency (in MHz) and f is the operating frequency of the transmitter (in MHz). The original equipment crystal formula was XTAL = f ÷ 12. When ordering crystals, the crystal vendor may require an "operating frequency" instead of a "crystal frequency". If this is so, convert to an operating frequency for a standard radio by dividing the 220MHz operating frequency by 18 and then multiplying the result by 12. The resulting frequency (in MHz) is the equivalent original equipment operating frequency. If you provide this operating frequency to a vendor and tell him it is for use in a GE MASTR Exec II, the crystal you receive from him will operate the exciter at the desired 220MHz frequency.

Receiver

Oscillator Multiplier Board

1. Install a 12pf capacitor in the space reserved for C412.

Orientation

The following steps require the board to be oriented in the following manner: component side up with the oscillator plug-in module (ICOM) in the upper left corner.

2. Short the bottom two turns of L403 (printed circuit inductor closest to you) to the junction of C417 and C419. There is a land in the printed circuit inductor for this purpose. It is located on

the right side of the turn in question. Solder a jumper wire from this land to the junction of the capacitors.

3. Short the center of L403 to the first turn above the center (towards the ICOM). Do this by removing the mask from a portion of the trace directly above the center of the printed circuit inductor and soldering a jumper from the trace to the center of the inductor.

Mixer Board

Orientation

The following step requires the board to be oriented in the following manner: component side up with the RCA type RF connector at the top.

Short the center of L502 (just to the left of the RCA connector, with a variable capacitor on it's right side) to the first turn above the center. Do this by removing the mask from a portion of the trace directly above the center of the printed circuit inductor and soldering a jumper from the trace to the center of the inductor.

RF Assembly

HOT!

The first step in this procedure requires the use of a propane torch. The coils mentioned are soldered directly to the metal casting of the RF front end, and standard bench-type soldering irons will not heat them effectively.

1. Remove 1 3/4 turns from L301/L311, L302/L312, L303/L313, L304/L314, L305/L315, L306/L316, and L307/L317 and re-install the coils.
2. Remove the plastic front panel from the radio deck by turning out the two screws in the handle and pulling the front panel away from the deck.
3. Looking at the back of the front plastic front panel, find and cut out the hole on the side opposite the opening for the input connections.

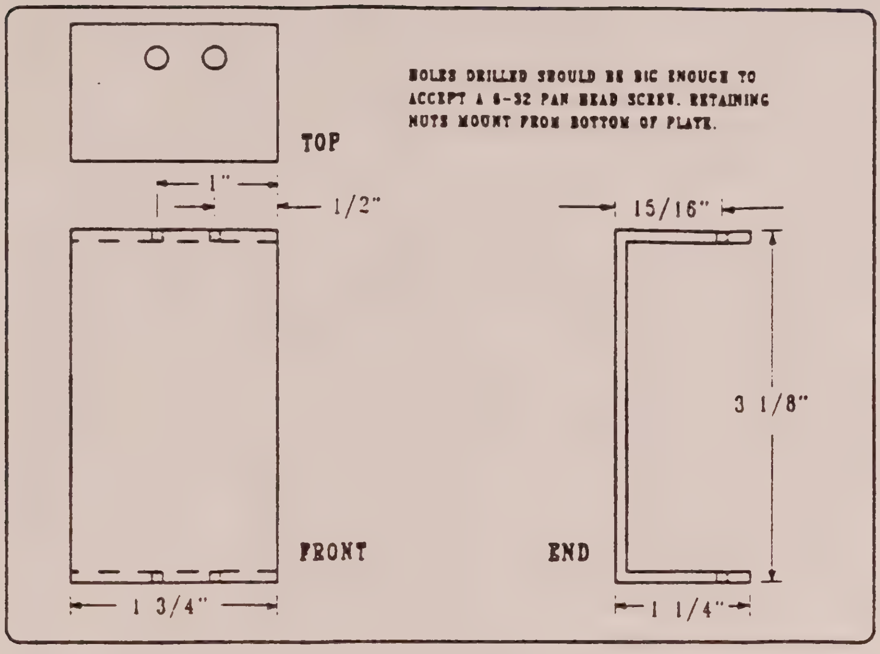


Figure 1-1. Receiver RF Connector Mounting Plate

4. Refer to Figure 1-1, *Receiver RF Connector Mounting Plate*, and construct the metal bracket which holds the receiver RF connector to the front of the radio deck. This plate will mount to the front of the radio deck casting opposite the stock interconnect cable mounting plate using existing mounting holes in the radio deck. When the new plate is mounted, drill holes to accept the UHF connector and shield assembly in it. Depending on the handle configuration of the plastic front panel which mounts to the radio deck, it may be necessary to "notch out" a portion of this bracket such that the front panel will seat properly. This notch will be about midway up the left side of the FRONT view shown in Figure 1-1.
5. Disconnect the cable (RCA connector) at the receiver input. Cut the other end of this cable from the rear casting of the radio deck at the antenna switch assembly. Solder the open end of this cable to the UHF connector and shield from the previous step. Reconnect the RCA connector to the receiver input and mount the UHF connector and shield to the mounting plate from step (4.).
6. Tune the receiver per the manual tuning procedure.

Note In the Vehicular Extender Units (VEUs), it is necessary to remove the attenuator in the receiver input. This is a small circuit board with one RCA type connector and three resistors mounted on it located just next to C301 and C302 in the RF front end. Connect the receiver input cable which had been connected to the attenuator directly to the RF front end input connector.

In the VEUs it may also be required to remove the 300mW power amplifier and antenna switch board to facilitate the installation of some other power amplifier assembly (see **Chapter 2**). **Save the RF filter network, it will be used in one of the 220MHz PA projects in chapter 2.** The PA itself, and the antenna switch module, may be discarded, as they are not required or useful in the 220MHz unit.

RX Crystals

The new crystal formula is XTAL = (f-11.2) ÷ 12 where XTAL is the crystal oscillating frequency (in MHz) and f is the operating frequency of the transmitter (in MHz). The original equipment crystal formula was **XTAL = (f-11.2) ÷ 9**. When ordering crystals, **the crystal vendor may require an "operating frequency" instead of a "crystal frequency". If this is so, convert to an operating frequency** for a standard radio by **subtracting 11.2 from the 220MHz operating frequency and dividing the result by twelve. Take the resulting** figure, multiply by 9, and add 11.2. The resulting frequency (in MHz) is the equivalent original equipment operating frequency. If you provide this operating frequency to a vendor and tell him it is for use in a GE MASTR Exec II, the crystal you receive from him will operate the exciter at the desired 220MHz frequency.

2

220MHz POWER AMPLIFIER

Several possibilities exist for a 220MHz Power Amplifier. The VHF high band board in the VEUs (or standard high band Executive II, for that matter), was designed with an upper operating frequency limit of 174MHz. Extensive modification of this board would be required to enable operation in the 220MHz band, and it is much more cost effective to build or buy a 220MHz power amplifier.

Special care must be taken in attenuating the harmonics of the 220MHz signal. There is no significant filtering of harmonics in the exciter, so potential amplifiers should utilize either pre-filtering at the input or RF PA filtering at the output, or both.

The exciter develops about 100mW of RF power. Some commercial power amplifiers are available which may provide up to 20 watts output when driven with this input, however most of them depend on the source to provide some sort of harmonic filtering.

This chapter includes documentation on application of a commercial power amplifier, and also on a built-up PA. The build-up includes typical operating parameters, parts list, and schematic.

Build-Up PA

This section describes the Power Amplifier built around an SAV-15 integrated circuit.

This power amplifier will develop about 25 watts with the 100 milliwatts input of a properly tuned exciter. The output is filtered for reduction of the second harmonic amplitude.

R1 through R3 comprise an attenuator to limit the input to IC1 to an acceptable range. Note that slight variation in values may be required to select optimum attenuation.

C3 through C7 and L1 through L4 comprise a low-pass pi network for harmonic filtering.

The Amplifier

IC1 is an SAV 15 broadband amplifier hybrid IC. It needs to be mounted on a heatsink or, better, to the chassis for heat dissipation. IC1 and C1, C2, C8 through C11, L5, and L6 should all be mounted in a shielded container to limit RF coupling problems.

C1 and C2 are surface mount components and should be mounted as closely as possible to the inputs of IC1. Positioning of the rest of the components mentioned in the previous paragraph is not critical, as long as they are all within the shield. All of the capacitors and inductors in this shielded container are for RF decoupling or power source filtering.

C12 and C13 are feedthru capacitors, supplying the DC voltages to the interior of the shielded container.

Q2 and R5 are taken from the MASTR Exec II high band PA assembly in stock (not VEU) radios. See parts list for details.

C14 is for power source filtering.

Table 2-1. Build-Up PA Parts List

Designator	Part Number	Description
C1		1000pf chip (surface mount) capacitor
C2		1000pf chip (surface mount) capacitor
C3		10pf un-cased mica capacitor
C4		20pf un-cased mica capacitor
C5		20pf un-cased mica capacitor
C6		20pf un-cased mica capacitor
C7		10pf un-cased mica capacitor
C8		4.7μf tantalum capacitor
C9		4.7μf tantalum capacitor
C10		470pf mica capacitor
C11		470pf mica capacitor
C12		1000pf chassis feedthrough capacitor
C13		1000pf chassis feedthrough capacitor
C14		47μf electrolytic
IC1	SAV-15	
L1		2 turns # 18 wire, 7/32 inch ID, 1/8 inch turn spacing
L2		2 turns # 18 wire, 7/32 inch ID, 1/8 inch turn spacing
L3		2 turns # 18 wire, 7/32 inch ID, 1/8 inch turn spacing
L4		2 turns # 18 wire, 7/32 inch ID, 1/8 inch turn spacing
L5		100μH
L6		100μH
Q1	2N2222	Silicon NPN transistor, TO-18
Q2		Q215 from original high band PA
R1		62Ω, 1/2W carbon resistor
R2		120Ω, 1/2W carbon resistor
R3		62Ω, 1/2W carbon resistor
R4		10KΩ, 1/2W carbon resistor
R5		5KΩ linear taper potentiometer
R6		1KΩ, 1/2W carbon resistor

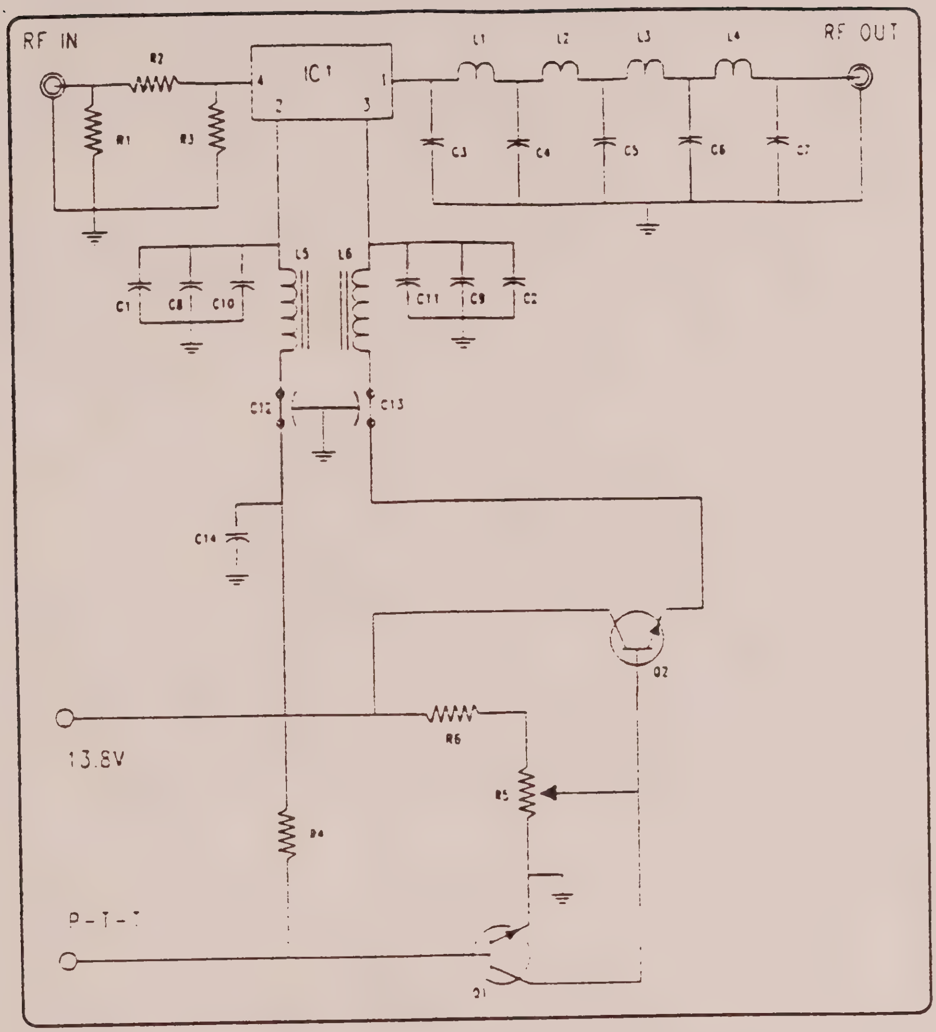


Figure 2-1. Build-Up 220MHz Power Amplifier

Commercial PA

This chapter explains the use of the Mitsubishi M57774 RF power module. This device is available through RF Parts Co., PO Box 700, San Marcos, CA 92069. (619) 744 0728. Use of this module allows the unit to develop 25 watts (adjustable) from the exciter input with minimal support circuitry.

The installation of this RF module also utilizes the original RF filter network from the VEU. It is adjusted for proper operation in the 220MHz band.

RF and A+ connections are made within the radio deck. No external circuitry is required, and the RF power module is bolted directly to the chassis for heatsinking and grounding. Use a good thermal compound to mount the module to the chassis. Some VEUs have extrusions on the deck which must be ground down to provide a flat mounting surface.

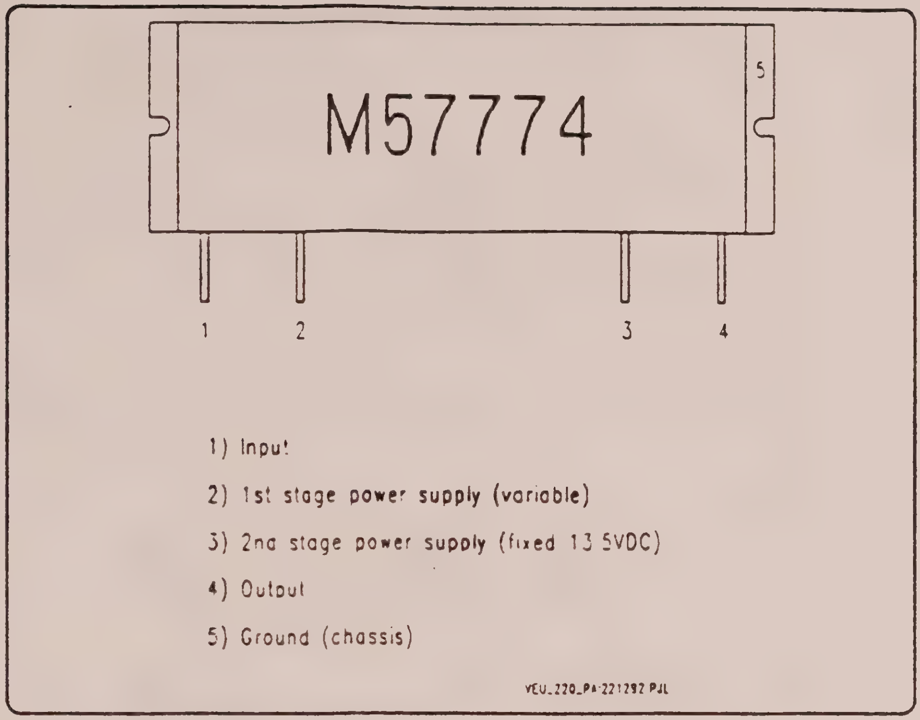


Figure 2-2. Mitsubishi M57774 Pinout Configuration

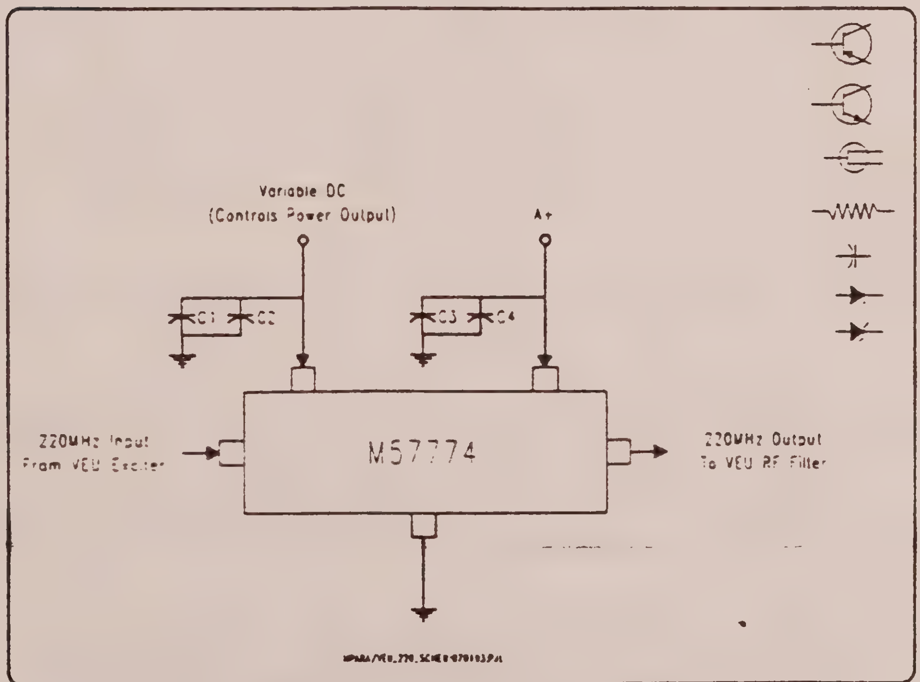


Figure 2-3. Commercial PA Schematic

Table 2-2. Commercial PA Schematic Parts List

Designator	Part Number	Description
C1		4700pf mica capacitor
C2		33μf electrolytic, 35WVDC
C3		4700pf mica capacitor
C4		33μf electrolytic, 35WVDC

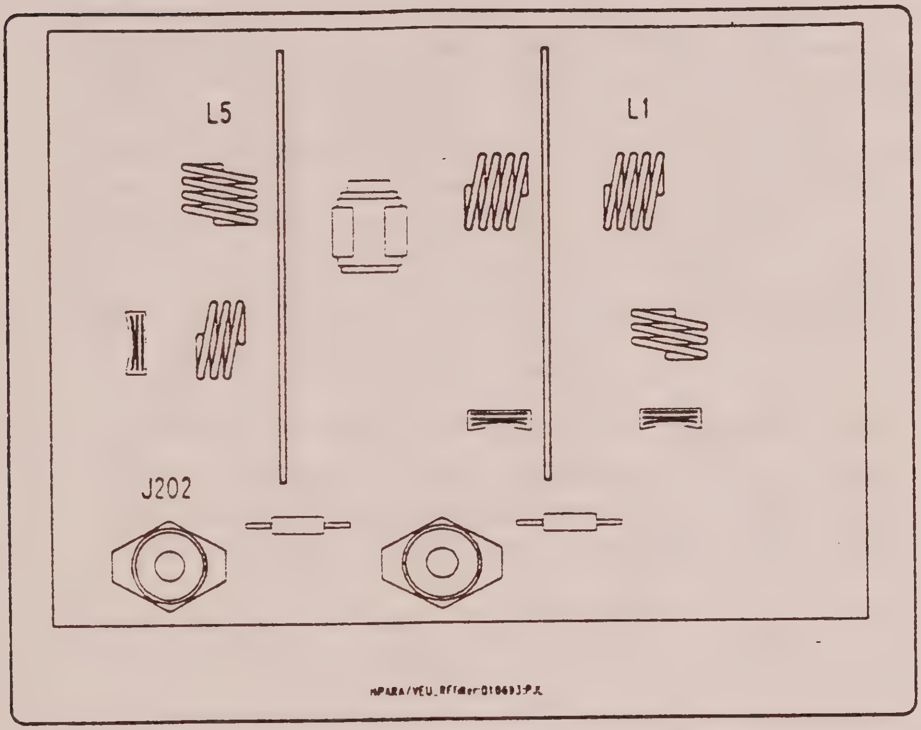


Figure 2-4. RF Filter Module

Figure 2-4 shows the stock RF filter found in the VEU. Tuning this for 220MHz requires manipulation ("spreading") of coils L1 and L5. They should be adjusted for exactly 1dB of insertion loss at the frequency of interest (220MHz). adjusting for lower loss may cause L3 **to become very HOT. Use caution. A network analyzer is very handy** for this job.

Connect the output of the RF power module directly to the input of the modified RF filter using 50Ω coaxial cable. Connect the output of the modified RF filter network to the transmitter RF connector on the front panel of the radio using the RCA jack J202 at the RF filter assembly.

Adjust the potentiometer shown in Figure 2-3 for the desired power output.

3

VEU SYSTEM BOARD MODIFICATIONS

Note This chapter deals exclusively with the Vehicular Extender Unit (VEU) as manufactured for the California Highway Patrol and documented in manual part number LBI32570. This modification was performed on combination number MVR16HS SPL, serial number 0386684. The technician should have a copy of this manual at his disposal for use in identifying parts and circuit board assemblies as reference is made to pin and connector numbers not shown in this document. Questions or comments regarding this procedure should be directed to Paul J. Lorona KB6MIP.

Warning This procedure is not usable for standard VHF high band radios.

1. Position the radio deck upside down with the handle facing you.
2. Remove the four screws holding the logic board to the chassis and remove the logic board from the radio deck. (See Figure 3-1 below for location of logic board.) Discard the logic board.

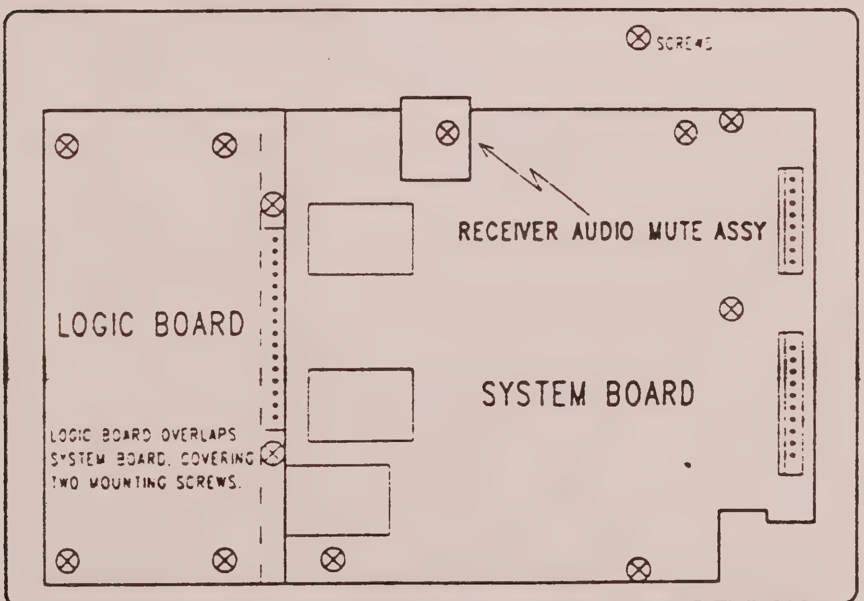


Figure 3-1. VEU RF Deck Board Location

Caution

Steps (3.) through (11.) of this procedure apply if the VEU is to be equipped with the **internal controller** documented in **Chapter 4**. If the internal controller is to be used, perform this entire procedure.

If an **external controller** is to be used, disregard steps (3.) through (11.) of this procedure, and continue with step (12.). **Chapter 5** documents external controller interfacing.

3. Temporarily remove the System Board by removing the cables connected to it, removing the screws, nuts, and standoffs as required, and removing it from the radio deck. There are eight screws holding the system board in the deck. One screw, the one holding the Receiver Audio Mute Assembly, is threaded into a standoff which must also be removed. There is a voltage regulator transistor on the lower right corner of the board, and it is mounted with a nut and lockwasher. These must also be removed.
4. Cut the Channel Guard modules off of the System Board as shown in Figure 3-2 below. Although exact path of cut is not critical, the units modified for this documentation used a path which started just left of the diodes shown to the left of the Receiver Audio Mute Assembly (shown as CAS Inverter Assembly in Figure 3-2) and proceeded roughly through the middle of the tone module housings as shown. The aluminum covers of the tone modules must be removed, as well as the modules themselves, before this cut can be made. Discard the Channel Guard portion of the System Board. Re-install the System Board in the radio deck and secure it with the required hardware (three screws will be left over).

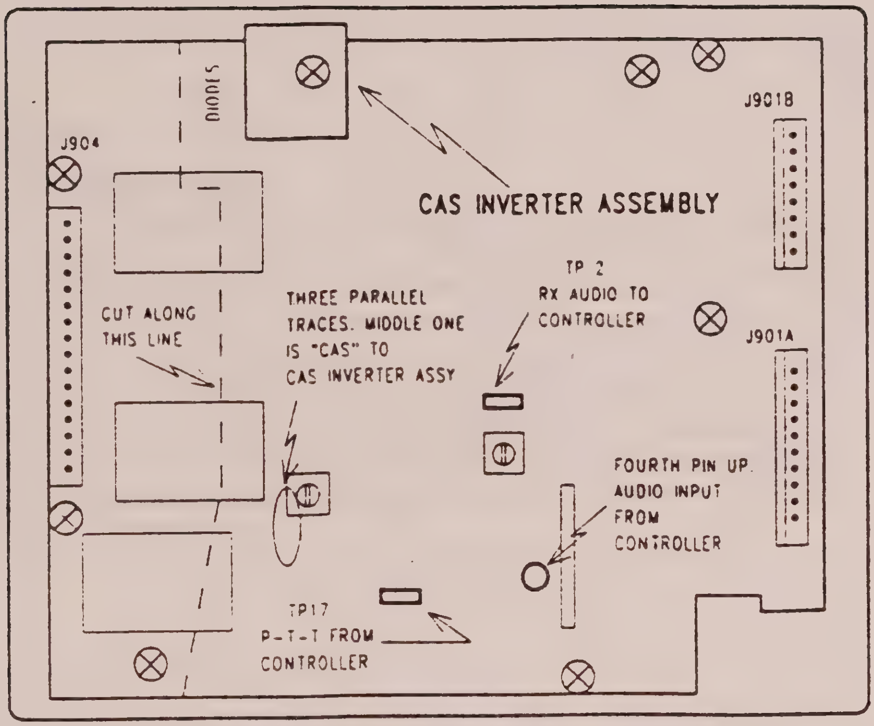


Figure 3-2. VEU System Board

5. Remove the RF Deck front panel plastic cover by turning out the two screws adjacent to the handle.
6. Remove the four screws holding the front panel connector bracket to the main chassis and fold out the bracket to expose the wires connected to the back of the connector.
7. Cut away all wires from the back of the connector.
8. Solder a black wire from pin 25 of the connector to J901A pin 6.
9. Solder a red wire from pin 28 of the front panel connector to J901A pin 10.
10. Modify an interconnect cable to provide +12VDC to pin 28 and ground to pin 25. All other wires may be removed. (the VEU cable is not a typical GE Exec II interconnect cable.)
11. Re-mount the connector bracket to the main chassis and replace the front panel plastic cover.
12. Solder a jumper from J903 pin 7 to J903 pin 3. This ties the receive oscillator control line to +10V, causing the receiver to always be active.

4

INTERNAL CONTROLLER INSTALLATION AND INTERFACE

Warning

This section documents the installation and interfacing of the WB6JHQ Repeater Controller to a VEU modified per the previous chapter (3). In general, the signal pickoff and injection points are the same as would be found in a standard Executive II, but there the similarity ends. The WB6JHQ Repeater Controller is a full feature control system on a 4 inch by 6 inch circuit board. For information regarding the WB6JHQ Repeater Controller contact Chuck WB6JHQ at (voice) 714 592 3135 or (BBS) 714 599 6612.

Installation

1. Refer to Figure 4-1. Move the tall standoff "A" to the location of short standoff "B". This will require removing standoff "B".
2. Using the Controller circuit board as a template, mark the location of a new hole for a third standoff. This third hole should be for the standoff which will be under the +5V REG voltage regulator in one corner of the Controller.
3. Drill the new standoff hole and move tall standoff "C" to the new hole.
4. Mount the Repeater Controller to the radio deck.

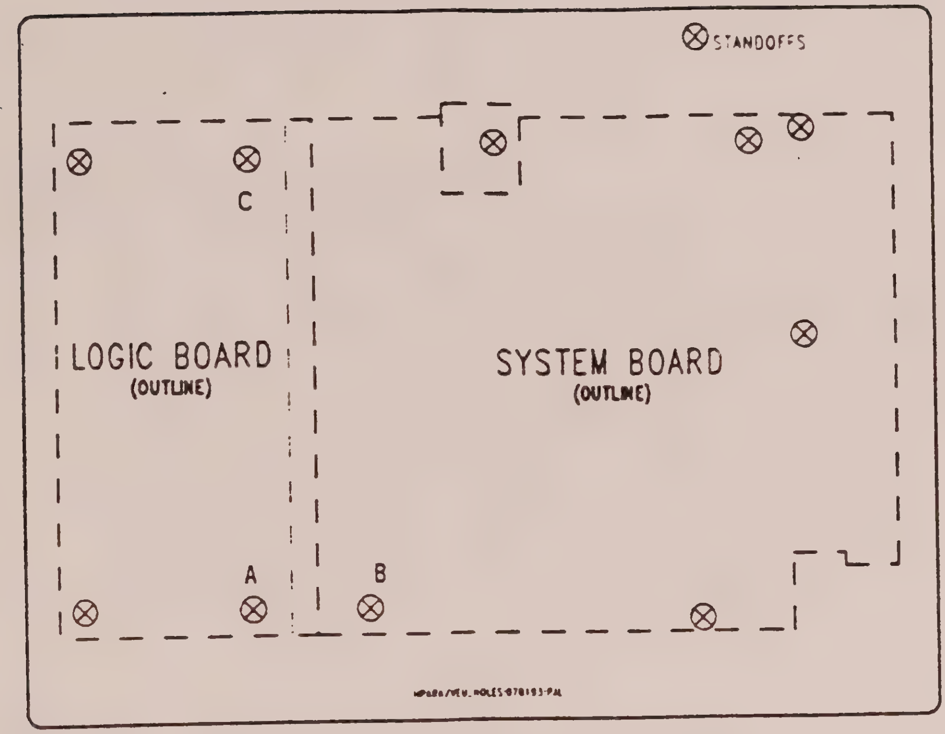


Figure 4-1. VEU Standoff Location

Interface

5

EXTERNAL CONTROLLER INTERFACE

This chapter describes modification to an existing interface cable and to the wiring harness inside the MASTR Executive II Vehicular Extender Unit. The VEU system board differs significantly from the System Audio Squelch (SAS) board of a stock radio. Generally speaking, a stock high band MASTR Exec II can be modified in a similar manner to that described within this chapter, but the technician should refer to the appropriate manual for location of required injection or detection points within the System board.

Refer to Figure 3-2 for the location of test points mentioned in the following procedures.

Radio Deck

1. Remove the RF Deck front panel plastic cover by turning out the two screws adjacent to the handle.
2. Remove the four screws holding the front panel connector bracket to the main chassis and fold out the bracket to expose the wires connected to the back of the connector.
3. Remove all wires from front panel connector which originate at J901B (upper right hand corner of assembly shown in Figure 3-2).
4. Remove all cables from the Molex connector at J901A except pins 6 (gray #16 AWG wire) and 10 (white #16 AWG).
5. Remove from the front panel connector all wires which originated at J901A.
6. Using the wires removed in steps (3.) through (5.), solder wires to the front panel connector as shown in the table below:

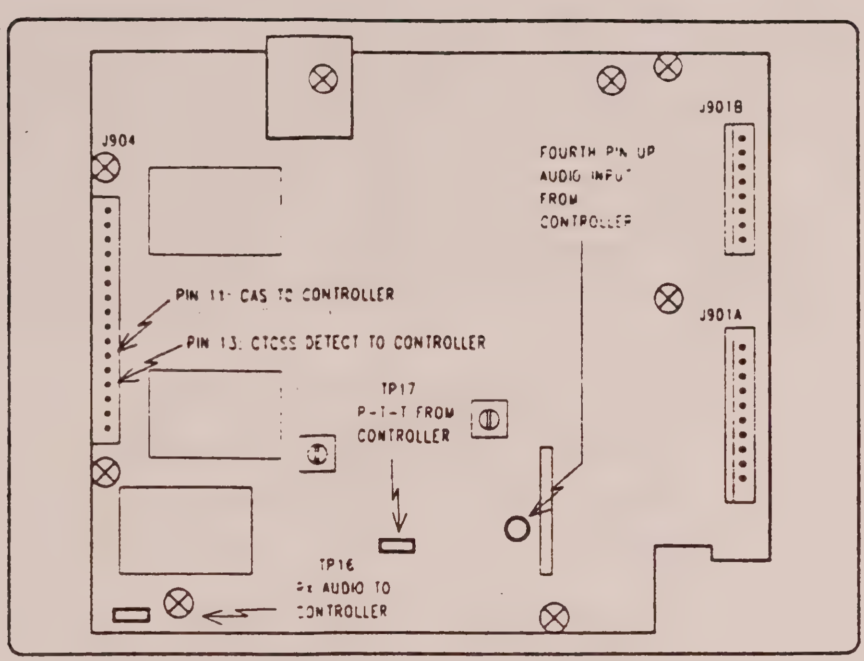


Figure 5-1. External Controller Interface Locations

9. Cut off any Molex pins which may be on the open ends of the wires soldered to the front panel connector in the previous steps.
10. Solder the **Orange** wire to TP17 on the System board. This is the Push-To-Talk lead from the external controller.
11. Solder the **White / Black** (center conductor) wire to TP16 on the System board. This is receiver audio for the external controller.
12. Solder the shield from the coaxial cable used in the previous step (White / Black) to a convenient nearby ground point on the System board.
13. Solder the **White / Red** (center conductor) wire to P902 pin 4 (lower center of Figure 3-2). This is the audio from the external controller for the exciter.
14. Solder the shield from the coaxial cable used in the previous step (White / Red) to P902 pin 5 or 6 (both are ground).

Interface Cable

Modify an interface cable to properly match up to the modified front panel connector. Any interface cable will work, as long as it's connector will mate to that of the VEU front panel. Wire colors shown here were obtained by modifying an interface cable from the original VEU application (MASTR Exec II VEU to Motorola MICOR deck and control group). Colors are unimportant, as long as one remembers which color provides which function, once all the equipment is back together.

Table 5-2. Interconnect Cable

Wire Color	Connector Pin #	Function
Yellow	26	A+
Black	25	A-
Orange	3	PTT
Coaxial Shields	9,4	Ground (A-)
Brown center conductor	5	TX Audio
Blue center conductor	10	RX Audio
Green center conductor	8	CAS
	7	CTCSS Detect

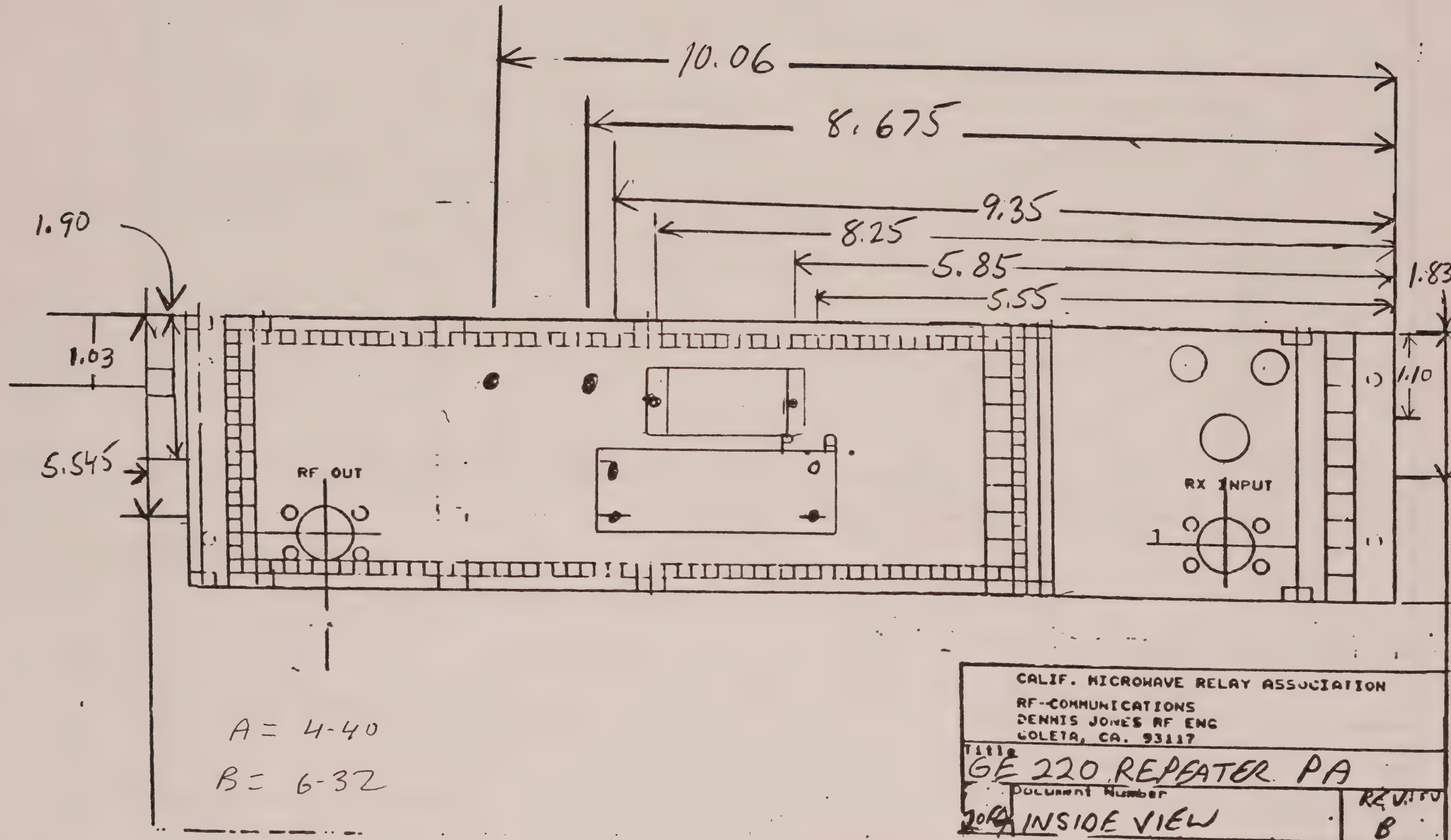
Other wires may remain connected to other pins in the cable, and these can be used to operate optional equipment and / or functions inside the VEU radio deck (such as stock or after-market CTCSS equipment).

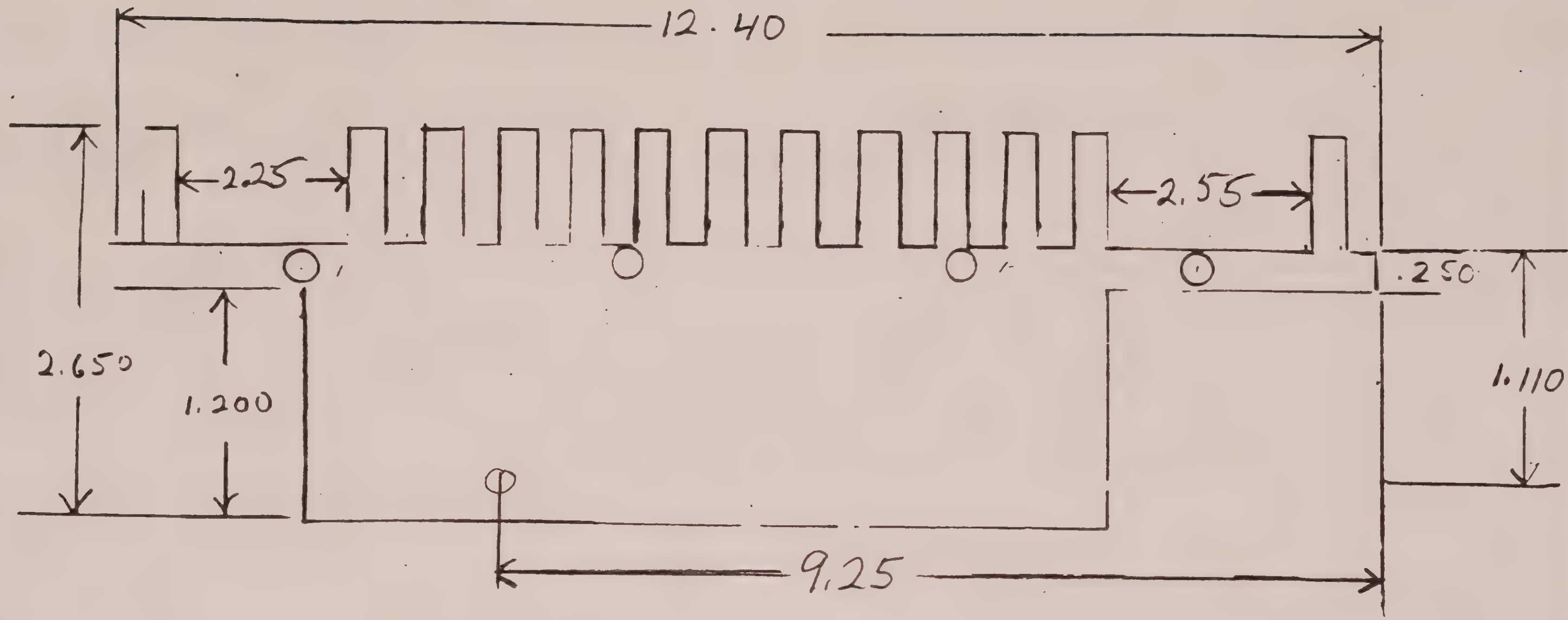
Signal Levels

- CAS: When no signal is present in the receiver (receiver squelched), the CAS line is held near ground. When a carrier is applied to the receiver, this line will go to approximately 9.2 volts. The squelch adjustment for the receiver, R25, is the leftmost of the two adjustments shown in Figure 5-1.
- CTCSS Detect: This line will be at a TTL high when no CTCSS tone is present in the received signal (i.e. the correct tone is not present). The line goes to TTL low when the correct tone is present.
- RX Audio: There can be up to 10 volts peak-to-peak of audio available at TP16, depending on the setting of R608 in the Limiter / Detector circuit. The load the controller presents to the signal line will determine the actual level. Adjusting R608 is acceptable,

provided the technician remembers that this will affect audio level at the local speaker (if installed).

Mark Gilmore WB6HRQ 12FEB91 chapters 1 and 2 REVA


10.06
8.675
9.35
8.25
5.85
5.55
1.83
1.90
1.03
5.545
1.10
RF OUT
RX INPUT
A = 4-40
B = 6-32
CALIF. MICROWAVE RELAY ASSOCIATION
RF-COMMUNICATIONS
DENNIS JONES RF ENG
GOLETA, CA. 93117
Title
GE 220 REPEATER PA
Document Number
INSIDE VIEW
REVISION
B



A = #2 DRILL x .250 COUNTERSINK 45°

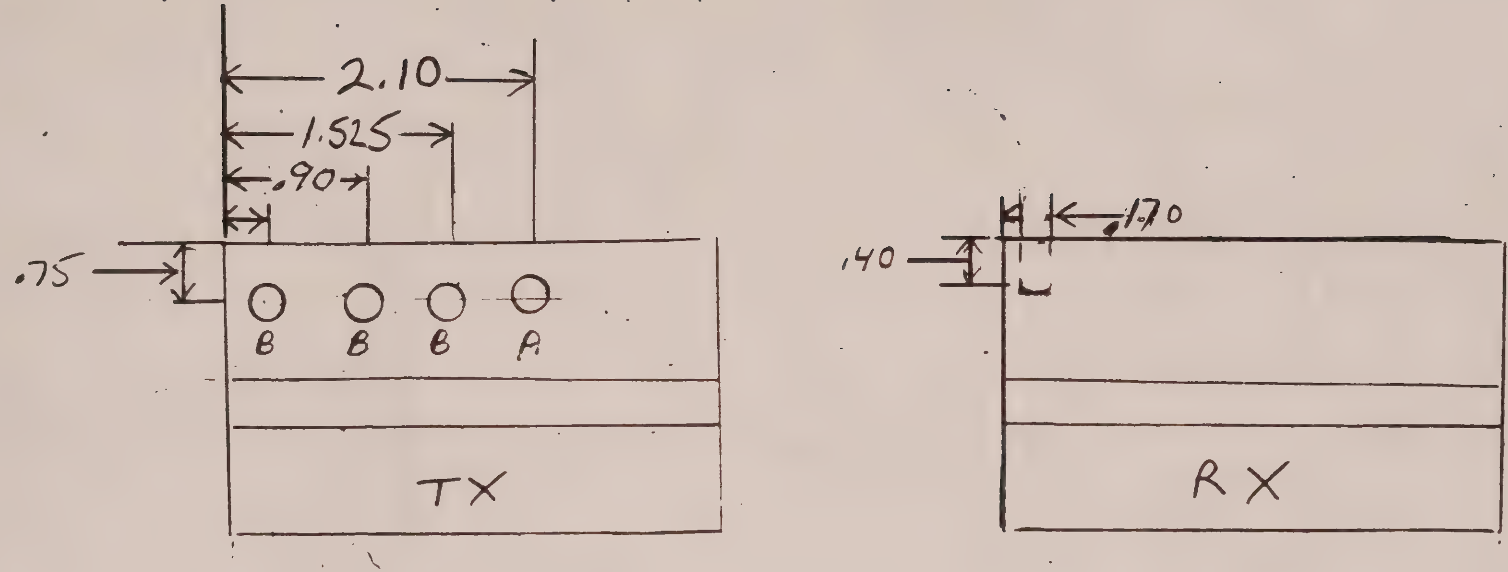
B = [illegible]

CALIF. MICROWAVE RELAY ASSOCIATION
RF-COMMUNICATIONS
DENNIS JONES RF ENG
GOLETA, CA. 93117

Title: GE 220 PA Bottom VIEW

Size: A | Document Number | REV

Date: 8-29-95



A =

B = .250 DRILLED HOLE

CALIF. MICROWAVE RELAY ASSOCIATION RF-COMMUNICATIONS DENNIS JONES RF ENG GOLETA, CA. 93117		
Title GE 220 PA SIDE VIEWS		
Size A	Document Number	REV 1
Date	8-29-95	

DOWN EAST MICROWAVE
Microwave Antennas And Components

Down East Microwave Inc.
954, RT 519,
Frenchtown, NJ 08825
Tel 908-996-3584
Fax 908-996-3702

220mHz LINEAR AMPLIFIER KIT

MODEL 220PAK

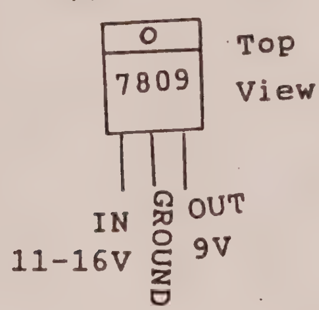
Specifications

Power in	100mW
Power out	16W linear, 20W saturated
Vcc	12-14VDC
Ic	3A peak
Frequency	420-450mHz
Active Device	MITSUBISHI M67712

Parts List

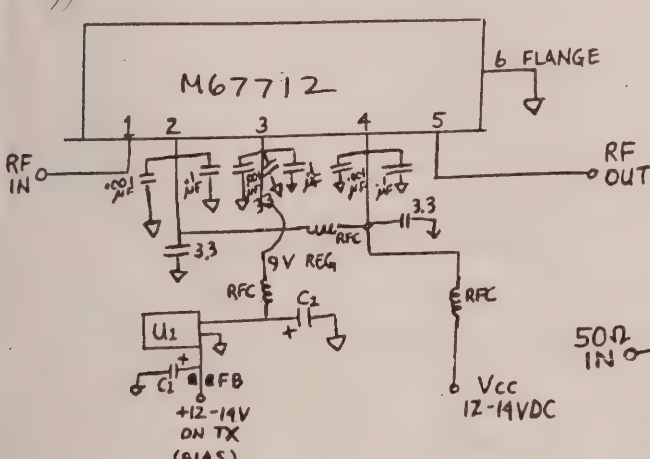
- 3- .1uF chip
- 3- .001uF chip
- 5- 3.3uF/16V tant.
- 1- M67712 module
- 1- 7809 regulator
- 1- ferrite bead
- 1- pcb
- 15"- #24 enamel wire

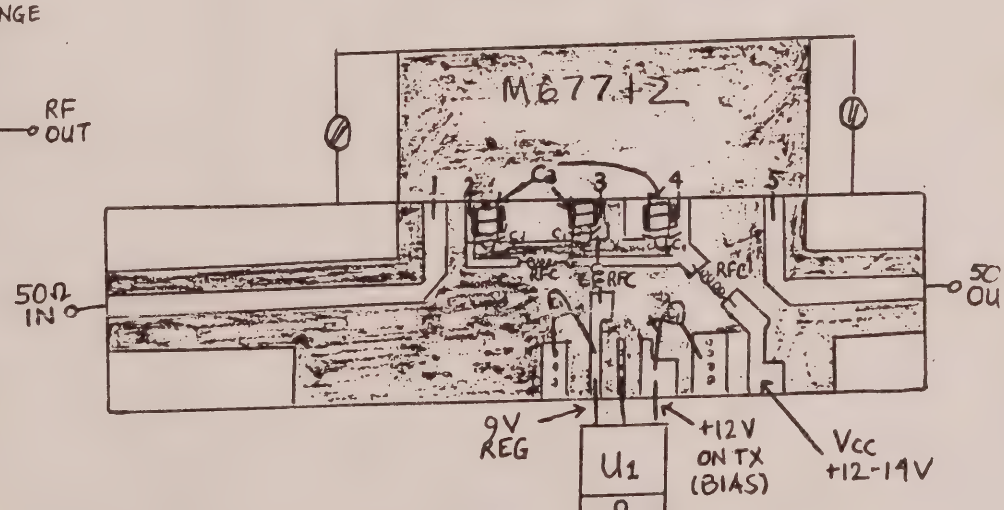
7809 9V REG



M67712 Pin Out

1. RF In
2. Vcc1
3. Bias
4. Vcc2
5. RF Out
6. RF and DC Ground (Flange)





Ca	.1uF, .001uF chips, 3.3uF tantalum in parallel
C1	3.3µF 16V Tantalum Electrolytic
U1	7809 Voltage Regulator (+9V @ 1A)
FB	Ferrite Bead
RFC	15 turns #24wire, 1/8"I.D.(note: 2 pcb traces must be cut to install RFCs.

For AM VIDEO, add 100µF Electrolytic from Vcc to ground, and Pin 3 to ground.
Amp will fit in BUD CU124 or HAMMOND 1590B box if regulator is bent up to fit on front wall.

M57774

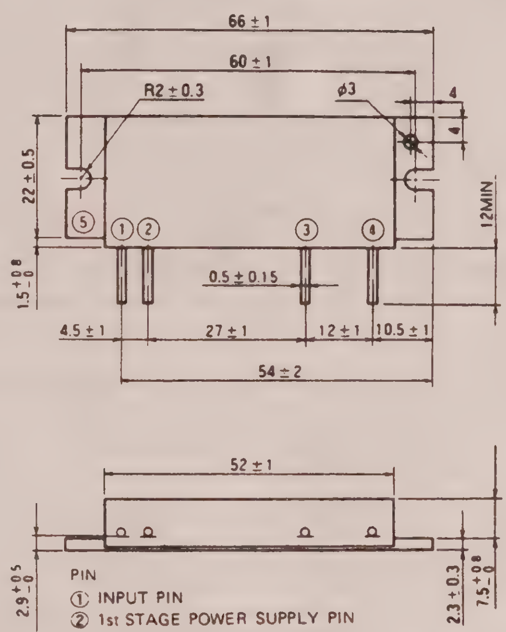
220~225MHz, 25W, FM MOBILE RADIO

DESCRIPTION
The M57774 is a thick film RF power module of 220 ~ 225MHz, 30W output, specifically designed for 220 ~ 225MHz, 25W FM mobile radios.

FEATURES
- High gain: $P_o \geqq 30W$ ($G_p \geqq 20dB$) @f = 220~225MHz, V_{CC} = 12.5V, P_{in} = 0.3W, $Z_G = Z_L = 50\Omega$
- High ruggedness: Ability to withstand more than 20:1 load VSWR when operated at f = 220 ~ 225MHz, V_{CC} = 15.2V, P_o = 30W.
- Wide operating case temperature: $T_{C(op)}$ = −30 ~ +110°C
- Small package: 23.5W x 66L x 9.8H (mm)
- Use of first stage AB class operation and feedback circuit enables continuous and stable amplification from low level to high level.

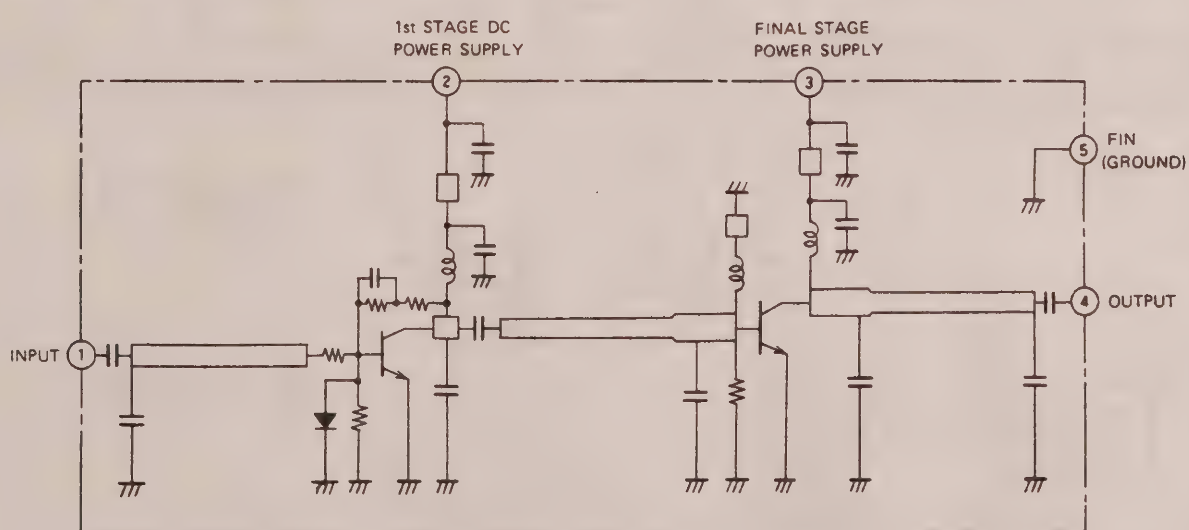
APPLICATION
Output stage of 220 ~ 225MHz, 25W FM mobile radio application

OUTLINE DRAWING
Dimensions in mm



PIN
① INPUT PIN
② 1st STAGE POWER SUPPLY PIN
③ FINAL STAGE POWER SUPPLY PIN
④ OUTPUT PIN
⑤ FIN (GROUND)

EQUIVALENT CIRCUIT



220~225MHz, 25W, FM MOBILE RADIO

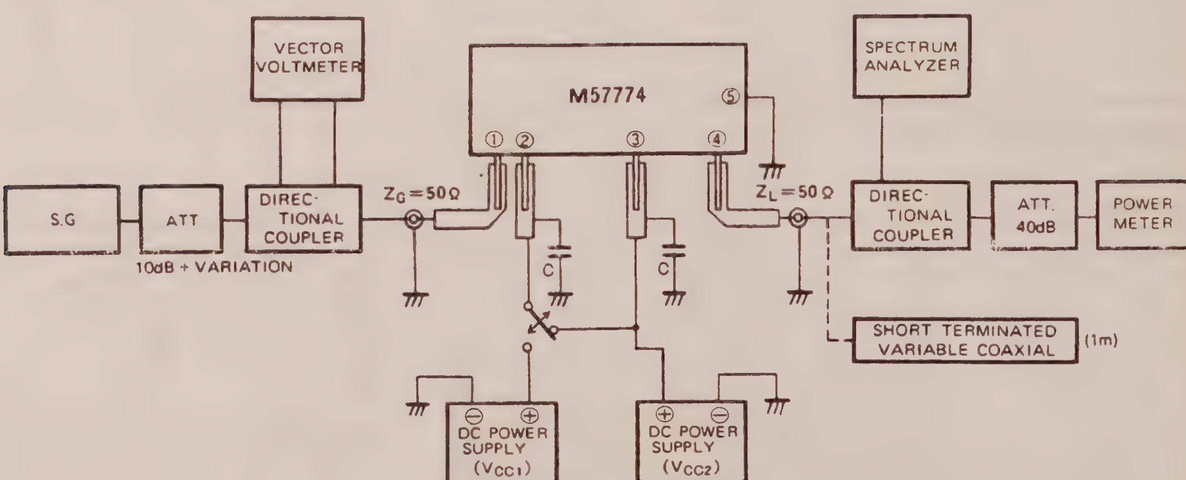
ABSOLUTE MAXIMUM RATINGS (T_C=25℃ unless otherwise specified)

Symbol	Ratings	Conditions	Value	Unit
V_{CC}	Supply voltage		17	V
I_{CC}	Total current		7	A
P_{in}	Input Power	$Z_G=Z_L=50\Omega$, $V_{CC1}\leqq 12.5V$	0.6	W
P_O	Output power	$Z_G=Z_L=50\Omega$	40	W
$T_{C(op)}$	Operation case temperature		−30~+110	℃
T_{stg}	Storage temperature		−40~+110	℃

ELECTRICAL CHARACTERISTICS (T_C=25℃ unless otherwise specified)

Symbol	Parameter	Test conditions	Limits Min	Limits Typ	Limits Max	Unit
P_O	Output power	V_{CC}=12.5V, f=220~225MHz P_{in}=0.3W, $Z_G=Z_L=50\Omega$	30	33		W
η_T	Total efficiency		43	48		%
	2nd harmonic				−30	dB
	3nd harmonic				−35	dB
ρ_{in}	Input VSWR				2.8	—
ρ_{out}	Output VSWR			1.5		—
	Load VSWR tolerance	V_{CC}=15.2V, f=220~225MHz, P_O=30W, $Z_G=50\Omega$	20 : 1			—

TEST BLOCK DIAGRAM

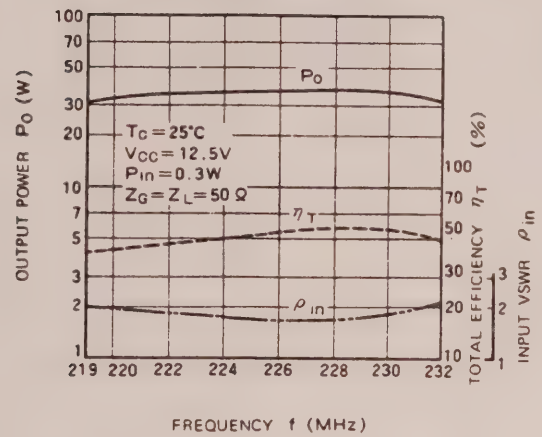


PIN:
① INPUT
② 1st STAGE POWER SUPPLY PIN
③ FINAL STAGE POWER SUPPLY PIN
④ OUTPUT PIN
⑤ FIN (GROUND)

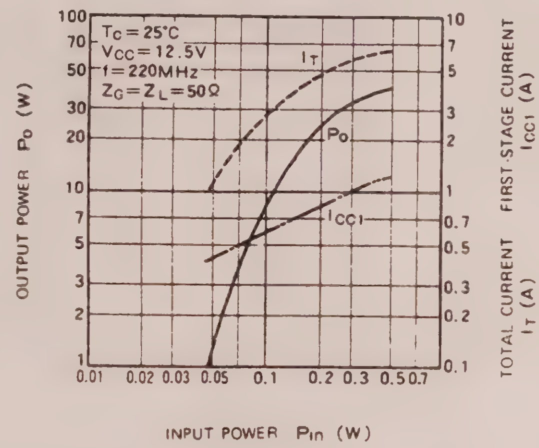
C: 4700pF, 33μF IN PARALLEL

TYPICAL CHARACTERISTICS

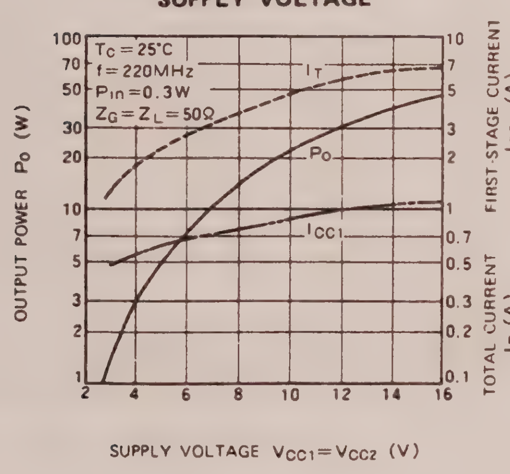
OUTPUT POWER, TOTAL EFFICIENCY, INPUT VSWR VS. FREQUENCY



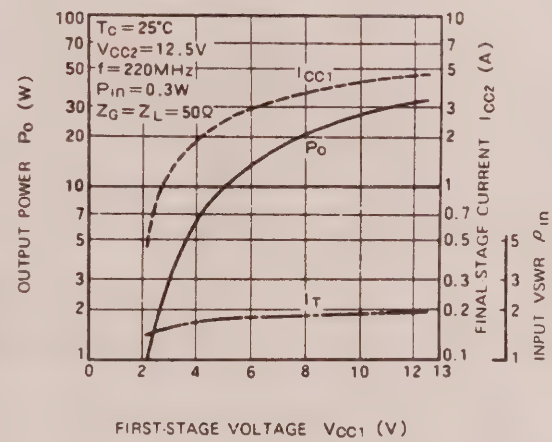
OUTPUT POWER, TOTAL CURRENT, FIRST-STAGE CURRENT VS. INPUT POWER



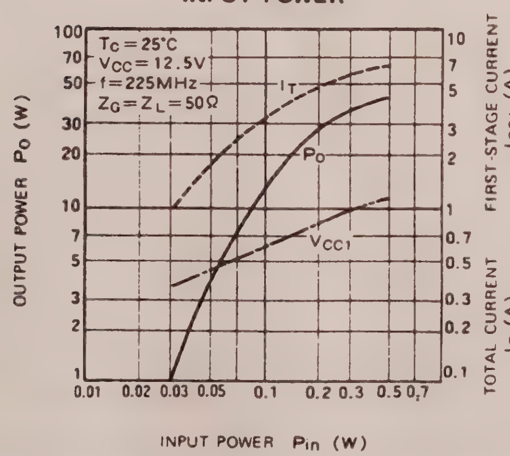
OUTPUT POWER, TOTAL CURRENT, FIRST-STAGE CURRENT VS. SUPPLY VOLTAGE



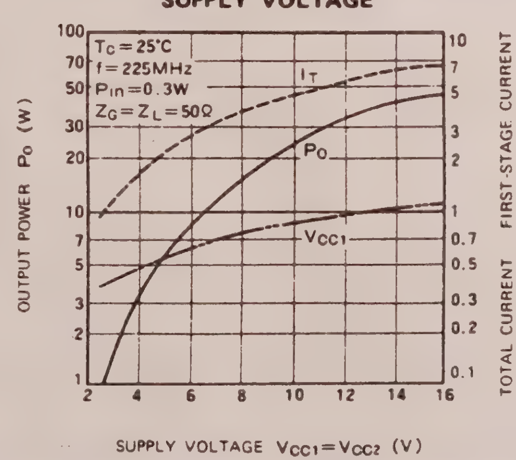
OUTPUT POWER, FINAL-STAGE CURRENT, INPUT VSWR VS. FIRST-STAGE VOLTAGE



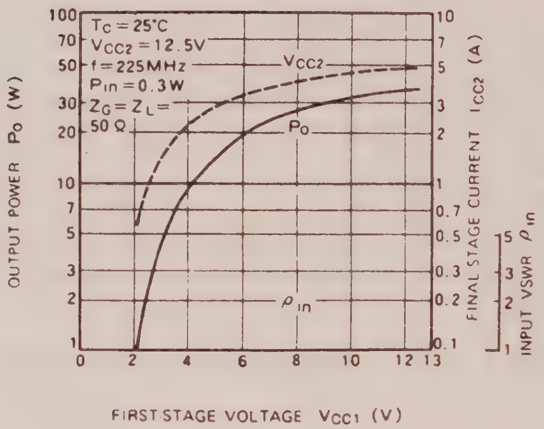
OUTPUT POWER, TOTAL CURRENT, FIRST-STAGE CURRENT VS. INPUT POWER



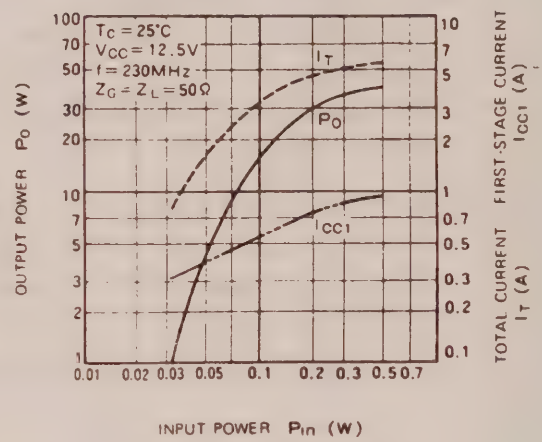
OUTPUT POWER, TOTAL CURRENT, FIRST-STAGE CURRENT VS. SUPPLY VOLTAGE



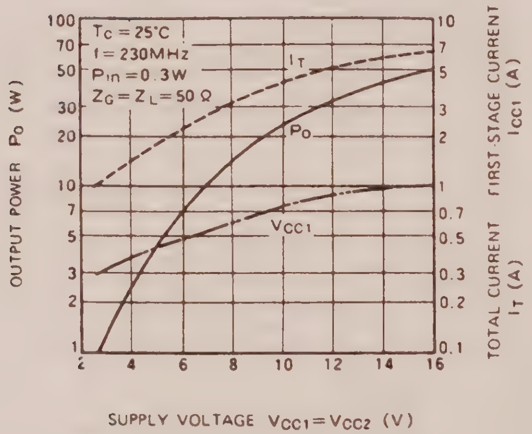
OUTPUT POWER, FINAL-STAGE CURRENT, INPUT VSWR VS. FIRST-STAGE VOLTAGE



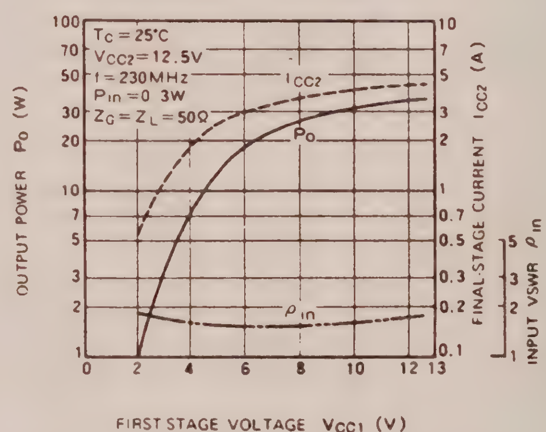
OUTPUT POWER, TOTAL CURRENT, FIRST-STAGE CURRENT VS. INPUT POWER



OUTPUT POWER, TOTAL CURRENT FIRST-STAGE CURRENT VS. SUPPLY VOLTAGE



OUTPUT POWER, FINAL-STAGE CURRENT, INPUT VSWR VS. FIRST-STAGE VOLTAGE



DESIGN CONSIDERATION OF HEAT RADIATION

Note the following when designing a heat sink:

1. Junction temperature of built-in transistor at standard operation

(1) Thermal resistance between junction of built-in transistors and case

Thermal resistance between junction of 1st stage transistor and case

$R_{th(j-c)1} = 8°C/W$ (typ.)

Thermal resistance between junction of final stage transistor and case

$R_{th(j-c)2} = 2°C/W$

(2) Junction temperature of built-in transistor at standard operation

- Standard operating conditions

  $P_o = 30W$, $V_{CC} = 12.5V$, $P_{in} = 0.3W$, $\eta_T = 43\%$ (rated minimum), $P_{O1} = 5W$(Note 1), $I_T = 5.6A$ (I_{T1}(Note 2) = 0.9A, I_{T2}(Note 3) = 4.7A)

  Note 1: Output power of 1st stage transistor

  Note 2: Current loss of 1st stage transistor

  Note 3: Current loss of final stage transistor

- Junction temperature of 1st stage transistor

  $T_{j1} = (V_{CC} \times I_{T1} - P_{O1} + P_{in}) \times R_{th(j-c)1} + T_C$(Note 4)

  $= (12.5 \times 0.9 - 5 + 0.3) \times 8 + T_C$

  $= 52 + T_C$ (°C)

  Note 4: Case temperature of device

- Junction temperature of final stage transistor

  $T_{j2} = (V_{CC} \times I_{T2} - P_o + P_{O1}) \times R_{th(j-c)2} + T_C$

  $= 912.5 \times 4.7 - 30 + 5) \times 2 + T_C$

  $= 68 + T_C$ (°C)

2. Heat sink design

To design the thermal characteristics of a heat sink, keep the case temperature below 90°C when output power P_o is 28W and the upper limit of ambient temperature T_a is 60°C.

The thermal resistance $R_{th(c-a)}$(Note 5) of a heat sink to achieve this:

$$R_{th(c-a)} = \frac{T_C - T_a}{\dfrac{P_o}{\eta_T} - P_o + P_{in}} = \frac{90 - 60}{\dfrac{30}{0.43} - 30 + 0.3}$$

Note 5: Including the contact thermal resistance between the device and the heat sink

Mounting the device on the heat sink with the above thermal resistance, junction temperatures of each transistor module becomes as follows:

$T_{j1} = 142°C$, $T_{j2} = 158°C$ at $T_a = 60°C$, $T_C = 90°C$,
Since the annual average of ambient temperature is 30°C, junction temperature of each transistor becomes as follows: $T_{j1} = 112°C$ and $T_{j2} = 17°C$.

Use of these built-in transistors in temperatures below the maximum junction temperature T_{jmax} 175°C is guaranteed.

M67712

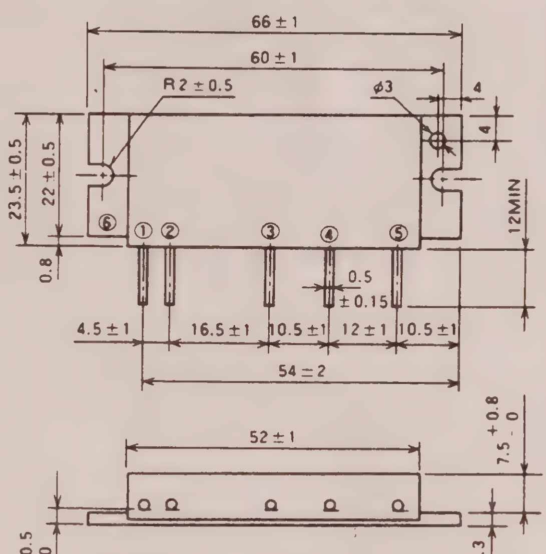
220～225MHz, 25W, SSB MOBILE RADIO

DESCRIPTION
M67712 is a thick-film RF Power Module specifically designed for 220 ~ 225MHz 25W SSB mobile radios.

FEATURES
- High power, High gain: $P_o \geqq 30W$, $G_p \geqq 20dB$, @V_{CC} = 12.5V, V_{bb} = 9V, f = 220 ~ 225MHz, P_{in} = 0.3W, Z_g = Zl = 50Ω.
- High power, High gain: $P_o \geqq 30W$, $G_p \geqq 20dB$, @V_{CC} = 12.5V, V_{bb} = 9V, f = 220 ~ 225MHz, P_{in} = 0.3W, Z_g = Zl = 50Ω.

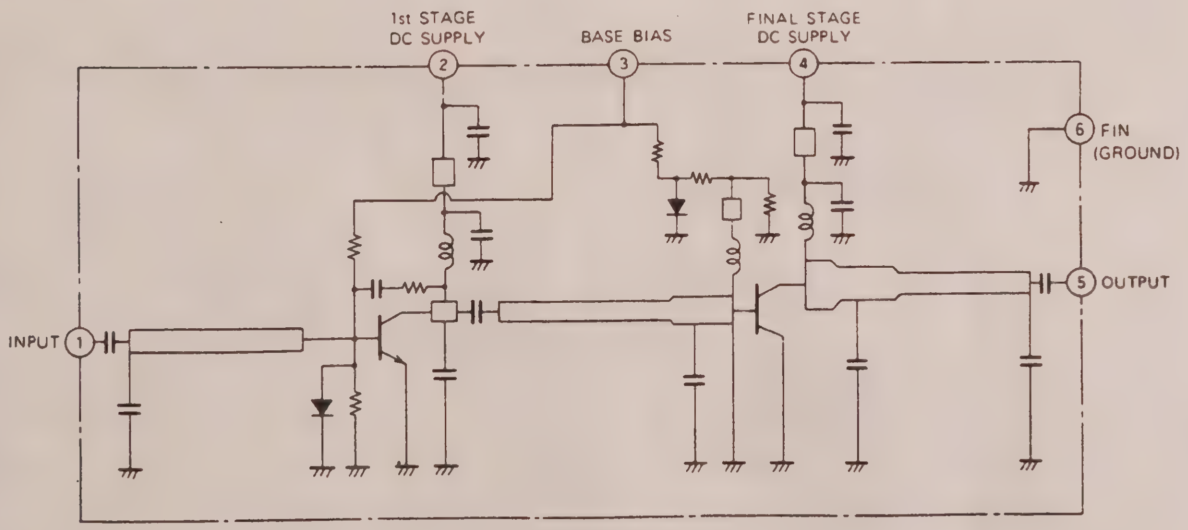
APPLICATION
For output stage of 25W mobile radio sets in 220 ~ 225MHz band.

OUTLINE DRAWING
Dimensions in mm



PIN
① INPUT TERMINAL
② 1st STAGE DC SUPPLY TERMINAL
③ 2nd STAGE DC SUPPLY TERMINAL
④ FINAL STAGE DC SUPPLY TERMINAL
⑤ OUTPUT TERMINAL
⑥ FIN (GROUND)

EQUIVALENT CIRCUIT



220～225MHz, 25W, SSB MOBILE RADIO

ABSOLUTE MAXIMUM RATINGS (Tc = 25°C unless otherwise noted)

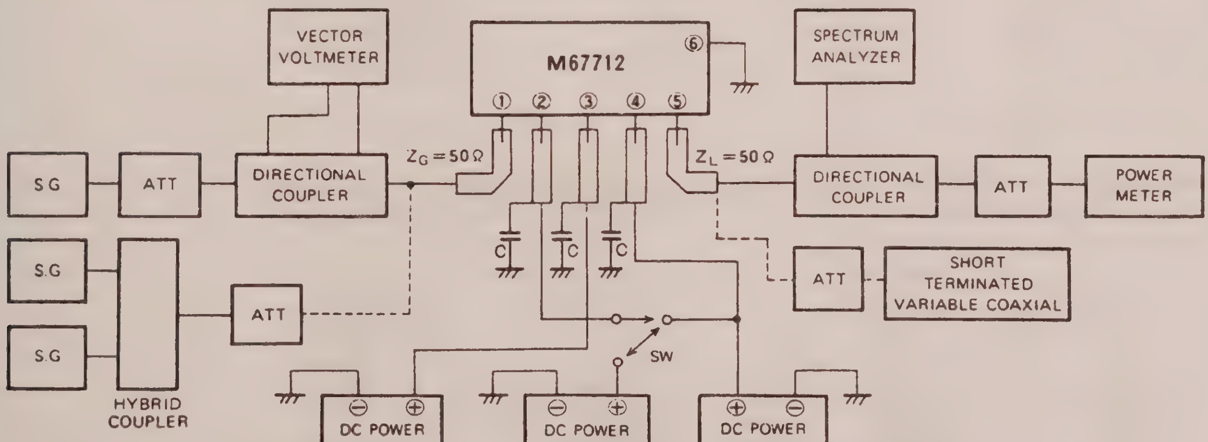
Symbol	Parameter	Conditions	Ratings	Unit
V_{CC}	DC supply voltage		17	V
V_{bb}	Base DC bias voltage		10	V
I_{CC}	Total current		7	A
P_{in}	Input power	$Zg = Zl = 50\Omega$	0.6	W
P_O	Output power	$Zg = Zl = 50\Omega$	40	W
$T_{C(OP)}$	Operation case temperature		−30～+110	°C
T_{stg}	Storage temperature		−40～+110	°C

ELECTRICAL CHARACTERISTICS (Tc = 25°C unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
P_O	Output power	$V_{CC} = 12.5V$, $V_{bb} = 9V$, $f = 220～225MHz$, $P_{in} = 0.3W$, $Zg = Zl = 50\Omega$	30	33		W
η_T	Total efficiency		43	48		%
—	2nd Harmonics				−30	dB
—	3rd Harmonics				−35	dB
ρ_{in}	Input VSWR				2.8	—
ρ_{out}	Output VSWR			1.5		—
—	Load VSWR tolerance	$V_{CC1} = V_{CC2} = 15.2V$, $V_{bb} = 9V$, $f = 220～225MHz$, $P_O = 30W$, $\rho_L \geqq 20$(All phase), $Zg = 5\Omega$	20 : 1			—
IMD 3	3rd internalmodulation distortion	$V_{CC} = 12.5V$, $V_{bb} = 9V$, $f = 220～225MHz$ P.E.P $\leqq 30W$, $\Delta f = 2kHz$, $Zg = Zl = 50\Omega$			−26	dB
IMD 5	5th internalmodulation distortion				−31	dB

P.E.P: Peak envelope power

TEST BLOCK DIAGRAM

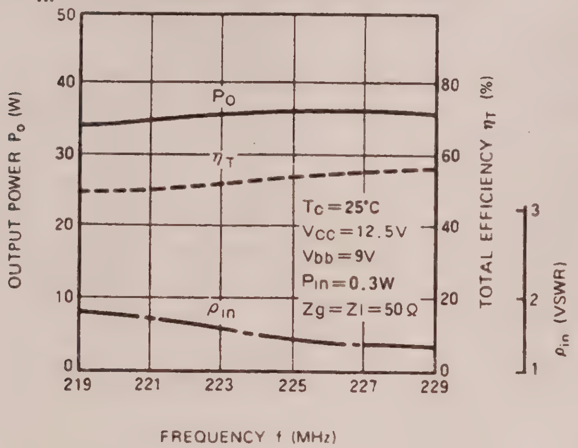


PIN:
① INPUT
② FIRST STAGE DC SUPPLY
③ BIAS DC SUPPLY
④ FINAL STAGE DC SUPPLY
⑤ OUTPUT
⑥ FIN (GROUND)

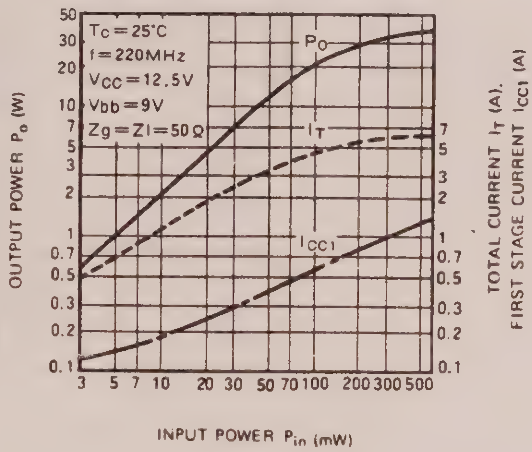
C: 4700pF, 22μF IN PARALLEL
BOARD MATERIAL
1.6mm THICK EPOXY-GLASS

TYPICAL PERFORMANCE DATA

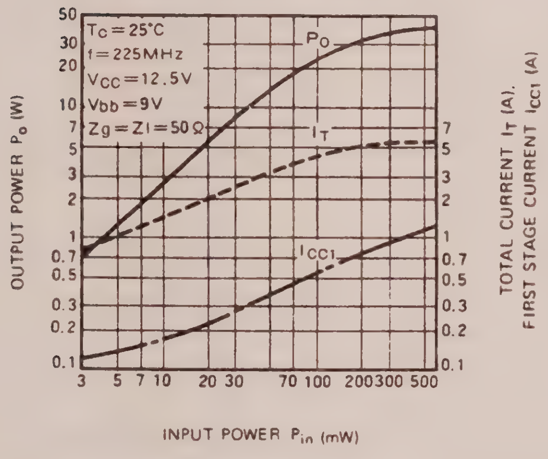
OUTPUT POWER, TOTAL EFFICIENCY, ρ_{in} VS. FREQUENCY CHARACTERISTICS



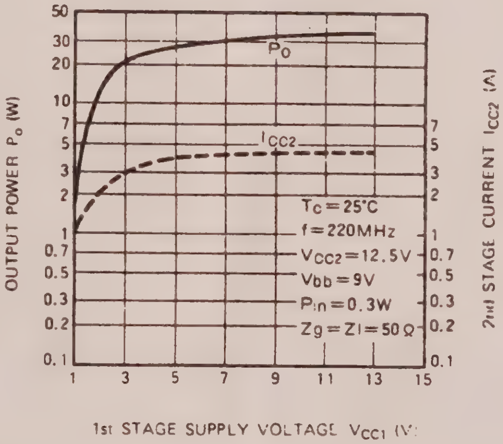
OUTPUT POWER, TOTAL CURRENT, 1st STAGE CURRENT VS. INPUT POWER CHARACTERISTICS



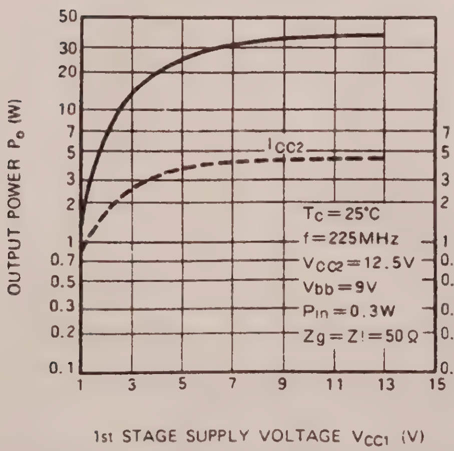
OUTPUT POWER, TOTAL CURRENT, 1st STAGE CURRENT VS. INPUT POWER CHARACTERISTICS



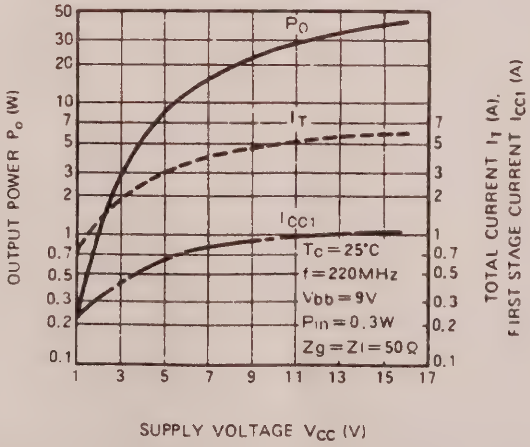
OUTPUT POWER, 2nd STAGE CURRENT VS. 1st STAGE SUPPLY VOLTAGE CHARACTERISTICS



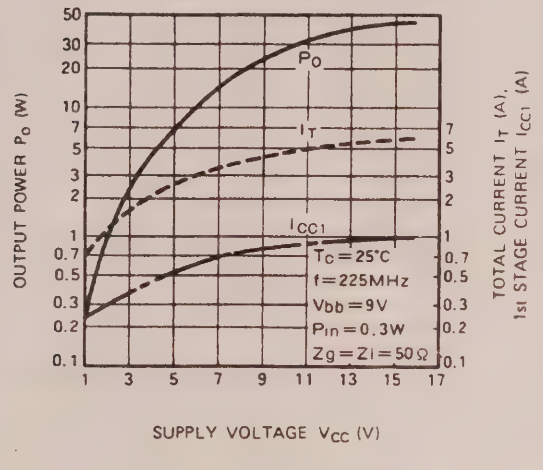
OUTPUT POWER, 2nd STAGE CURRENT VS. 1st STAGE SUPPLY VOLTAGE CHARACTERISTICS



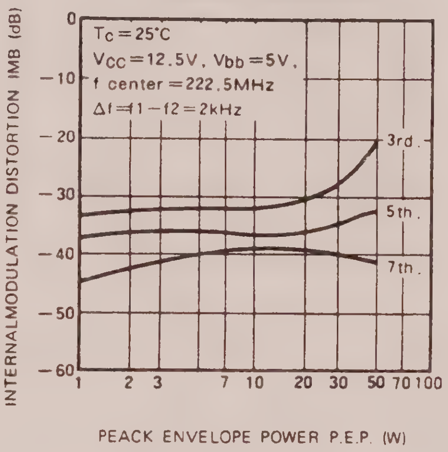
OUTPUT POWER, TOTAL CURRENT, 1st STAGE CURRENT VS. SUPPLY VOLTAGE CHARACTERISTICS



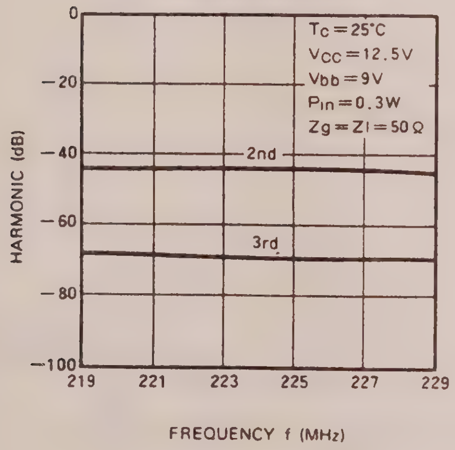
OUTPUT POWER, TOTAL CURRENT, 1st STAGE CURRENT VS. SUPPLY VOLTAGE CHARACTERISTICS



INTERNALMODULATION DISTORTION VS. PEACK ENVELOPE POWER CHARACTERISTICS

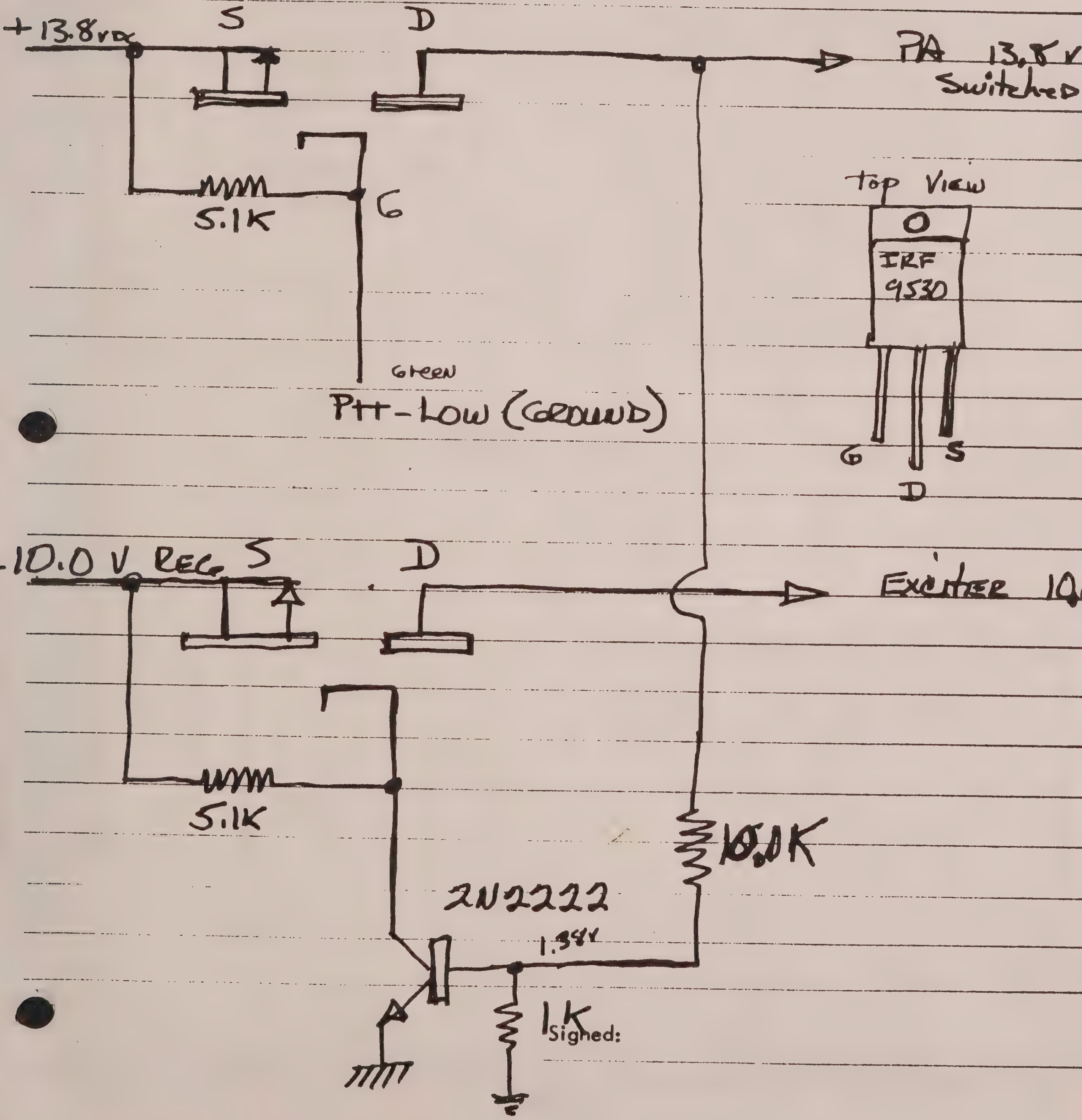


2nd, 3rd HARMONIC VS. FREQUENCY CHARACTERISTICS



Date 19

SUBJECT: IRF-9530 8 Amp



Signed:

Project Planner

Project: Target Date:

Objective:

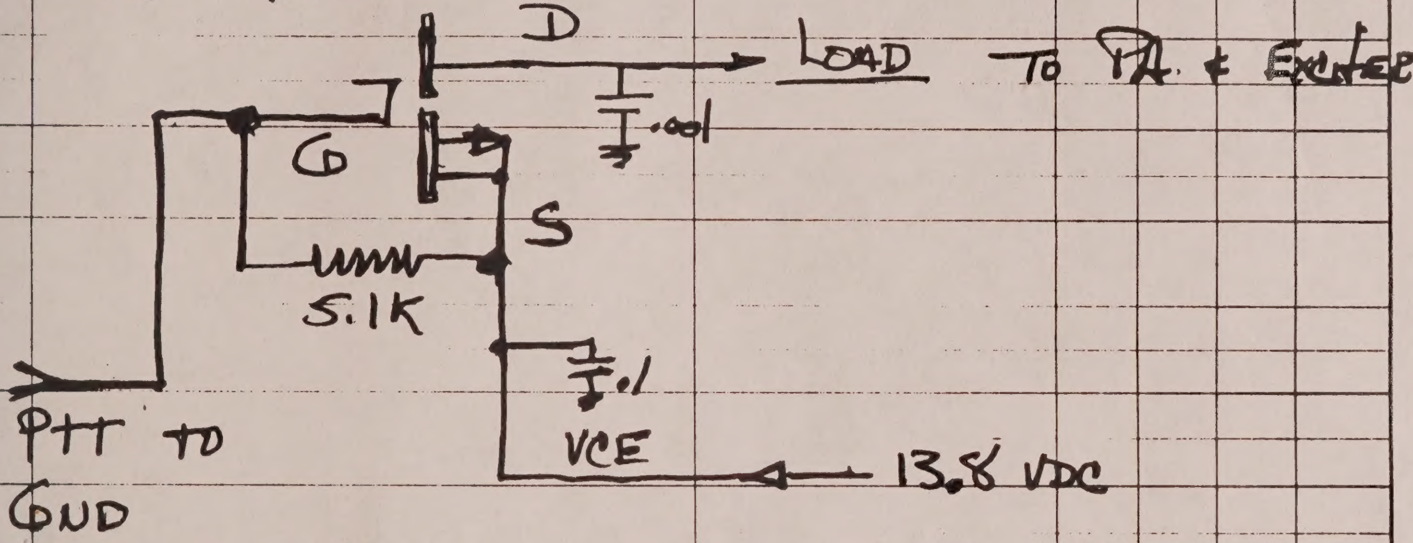
Expected Result:

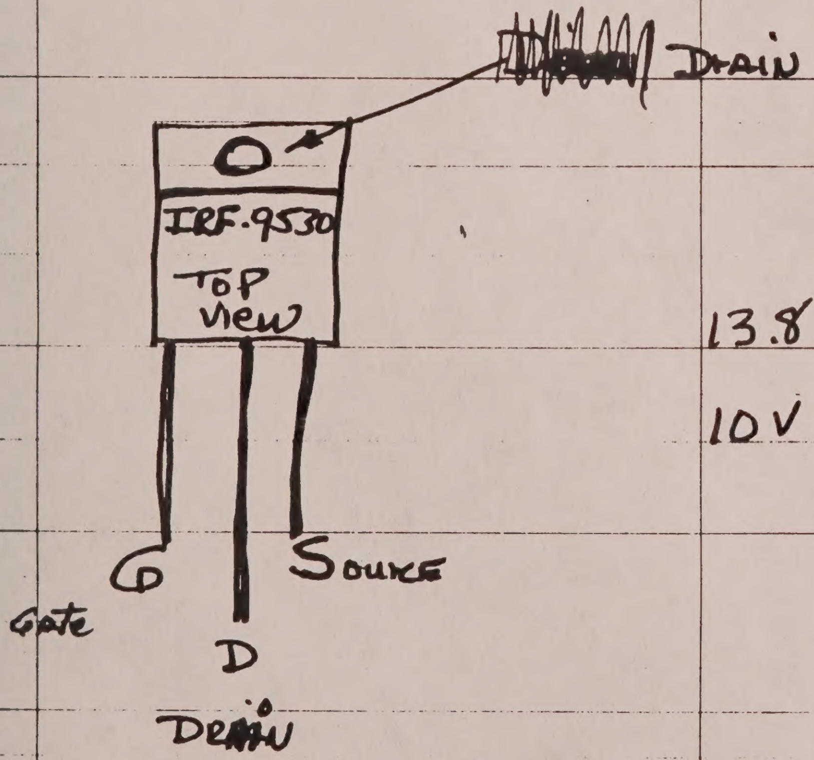
Estimated Cost:

Strategy Check Team Leader:

No.	◀ Action Steps ▶ Primary Tasks	Related Tasks	I / We Will Need These Resources People / Equipment / $ / Facilities	Seq.	Days / Hours	Start Date	Compln. Date

IRF-9530





13.8 VDC - TO — PA Switched

10V VDC - TO — EXCITER

All Items Time Activated ✓ Total Cost $ Completion Date ➤

TIME:TEXT.